MEDICAL ACTIVITIES AND MEDICAL COMMUNICATIONS DURING AN AMPHIBIOUS ASSAULT AND SUBSEQUENT OPERATIONS ASHORE

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Summary

Medical activities and medical communications play a vital part in support of Marine Corps amphibious operations and subsequent operations ashore. This report focuses on these medical activities and medical communications. Medical activities is the subject of the first half of this report, and medical communications is the subject of the second half of this report.

Prior to this report, a detailed and thorough research and analysis of Marine Corps operations was conducted that led to the generation of a future combat scenario and its associated conclusions. It was clear that many improvements needed to be made to ensure that we survive and win any encounters with our projected opponents. These needed improvements in medical activities and medical communications come at the same time as the occurrence of advances in technology that are available to realize these needed improvements.

Now is the time to apply this new technology to help make the medical support as effective and efficient as possible from the beginning to the end of any MAGTF operations. Keywords: Combat medical services; radio communication; patients; medical; command, control and communications; (KT)

Medical Activities and Medical Communications during an Amphibious Assault and Subsequent Operations Ashore

Introduction

Purpose

The purpose of this report is to document the functional description and specifications for the communications necessary from the 3rd echelon (Medical Company) rearward. Part I of this report provides the context to understand the problem. Part II of this report outlines the functional requirements and specifications of the medical communications.

General

This report reviews the establishment, operation and maintenance of medical activities (in Part I) and the medical communications (in Part II) during an amphibious assault and subsequent operations ashore. In addition, the command structure, planning techniques, and communications paths relating to medical field units and their patients is delineated. This report also covers the movement of patient medical records and the basic communications equipment configurations for High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF), and Satellite communications. While the focus is primarily on the assault phase of an amphibious operation, it is applicable to most phases of an assault, raid, withdrawal, or sustained operations ashore where the Commander of the Landing Force (CLF) is supported by an Amphibious Task Force/ Landing Force (ATF/LF).

Maritime Prepositional Ships (MPS) Brigade

The procedures outlined in this report are also applicable to the MPS Brigade or other landing force where they are not supported by an ATF. In this case, CLF will be responsible for the establishment of the medical regulating system and for coordination with other higher headquarters medical regulating agencies for evacuation of casualties out of his area of responsibility (AOR).

Joint Operations

The information in this report is also applicable to U.S. Army and Air Force units when assigned as part of a joint command in amphibious operations. The exchange of liaison personnel and medical regulating teams is encouraged to ensure the smooth coordination of medical assets and to increase the effectiveness of patient care.

PART I

MEDICAL ACTIVITIES

ACRONYMS AND ABBREVIATIONS

ACE	- Aviation Combat Element
ACP 125(D)	- Allied Communication Publication, Radiotelephone Procedures
AECC	- Aeromedical Evacuation Control Center
AELT	- Aeromedical Evacuation Liaison Team
AES	- Aeromedical Evacuation Squadron
ALCC	- Airlift Control Center
ALCE	- Airlift Control Element
AMRCC	- Alternate Medical Regulating Control Center
AMRCO	- Alternate Medical Regulating Control Officer
AOA	- Amphibious Operating Area
AOR	- Area of Responsibility
ASMRO	- Armed Services Medical Regulating Office
ATF	- Amphibious Task Force
BAS	- Battalion Aid Station
BES	- Beach Evacuation Station
BSSG	- Brigade Service Support Group
CATF	- Commander, Amphibious Task Force (USN)
CEO	- Communications-Electronics Officer
CG	- Commanding General
CIC	- Combat Information Center
CINC	- Commander-in-Chief
CINCAFLANT	- Commander-in-Chief of the Atlantic Air Force
CINCLANT	- Commander-in-Chief, Atlantic
CLF	- Commander, Landing Force (USMC)
CONUS	- Continental United States
CRTS	- Casualty Receiving and Treatment Ship
CSS Net	- Combat Service Support Net
CSSE	- Combat Service Support Element
DASC	- Direct Air Support Center
DOD	- Department of Defense

EEFI	- Essential Elements of Friendly Information
FSSG	- Force Service Support Group
G-3	- Operations (USMC)
G-4	- Logistics (USMC)
GCE	- Ground Combat Element
HCS	- Helicopter Coordination Section
HDC	- Helicopter Direction Center
HES	- Helicopter Evacuation Station
HLZ	- Helicopter Landing Zone
HR	- Helicopter Request
HSSO	- Health Services Support Officer
HST	- Helicopter Support Team
JMRO	- Joint Medical Regulating Office
LCC	- Amphibious Command Ship
LF	- Landing Force
LFOC	- Landing Force Operations Center
LFSP	- Landing Force Support Party
LHA	- Amphibious Assault Ship (general purpose)
LHD	- Amphibious Assault Ship (multi-purpose)
LKA	- Amphibious Cargo Ship
LPD	- Amphibious Transport Dock
LPH	- Amphibious Assault Ship (helicopter)
LSD-41 Class	- Dock Landing Ship, "Whidbey Island" Class
LST	- Tank Landing Ship
MAB	- Marine Amphibious Brigade
MAC	- Military Airlift Command
MAF	- Marine Amphibious Force
MAG	- Marine Air Group
MAGTF	- Marine Air-Ground Task Force
MASF	- Mobile Aeromedical Staging Facility

MAU	- Marine Amphibious Unit
MAW	- Marine Air Wing
MEB	- Marine Expeditionary Brigade
MEF	- Expeditionary
MEW	- Expeditionary
M-MART	- Medical Mobilization Augmentation
MPS	- Maritime Prepositioned Ship
MRC	- Medical Regulating Center
MRCO	- Medical Regulating Control Officer
MRS	- Medical Regulating Section
MRT	- Medical Regulating Team
MRT/S	- Medical Regulating Team/Section
MSOC	- Medical Support Operations Center
MSSG	- MEU Service Support Group
MTF	- Medical Treatment Facility
N-3	- Operations (USN)
N-4	- Logistics (USN)
NATO	- North Atlantic Treaty Organization
NWP	- Naval Warfare Publication
OPCON	- Operational Control
OPLAN	- Operation Plan
OPORD	- Operation Order
PCS	- Primary Control Ship
SAS	- Squadron Aid Station
SCRTS	- Secondary Casualty Receiving Treatment Ship
TACC	- Tactical Air Control Center
TAES	- Tactical Aeromedical Evacuation System
TAR Net	- Tactical Air Request Net
USAF	- United States Air Force
US ARMY	- United States Army

COMMAND STRUCTURE

The United States Marine Corps Fleet Marine Forces are task organized into Marine Air-Ground Task Forces (MAGTFs). Each MAGTF is composed of a Command Element, a Ground Combat Element (GCE), an Aviation Combat Element (ACE), Marine Expeditionary Unit (MEU), Marine Expeditionary Brigade (MEB) and a Combat Service Support Element (CSSE). Figure 1 shows the command separation and transfer of command from sea to land upon establishment of a beachhead.

The MAGTF may vary in size depending on need or orders. The smallest MAGTF is a Marine Amphibious Unit (MAU). The next larger MAGTF is a Marine Amphibious Brigade (MAB), and the largest MAGTF is a Marine Amphibious Force (MAF). Figures 2, 3, and 4 show the command structure of each of the MAGTFs.

An MAU is normally commanded by a colonel. The MAU GCE is normally a battalion landing team; the MAU ACE is normally a composite squadron; and the appropriate MAU CSSE is called a MAU Service Support Group (MSSG).

An MAB is normally commanded by a brigadier general. The MAB GCE is normally a regimental landing team; the MAB ACE is a provisional Marine Aircraft Group (MAG); and the appropriate MAB CSSE is a Brigade Service Group (BSSG).

An MAF is commanded by either a major general or a lieutenant general, depending on its size and mission. The MAF GCE is normally a Marine division; the MAF ACE is a Marine Aircraft Wing (MAW); and the appropriate MAF CSSE is a Force Service Support Group (FSSG).

Corpsmen and Battalion Aid Stations (BASs) are organic to the GCEs, Corpsmen and Squadron Aid Stations (SASs) are organic to ACEs, and Medical Companies and Hospital Companies are organic to the CSSEs.

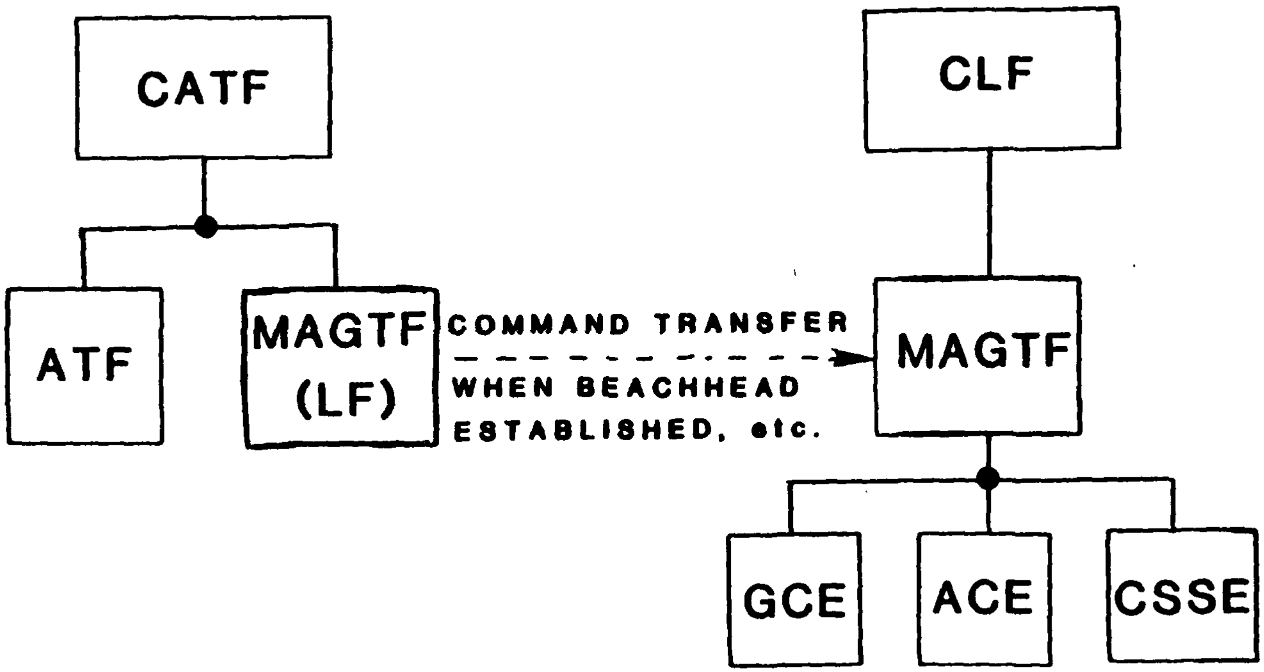

FIGURE 1. GENERAL COMMAND STRUCTURE

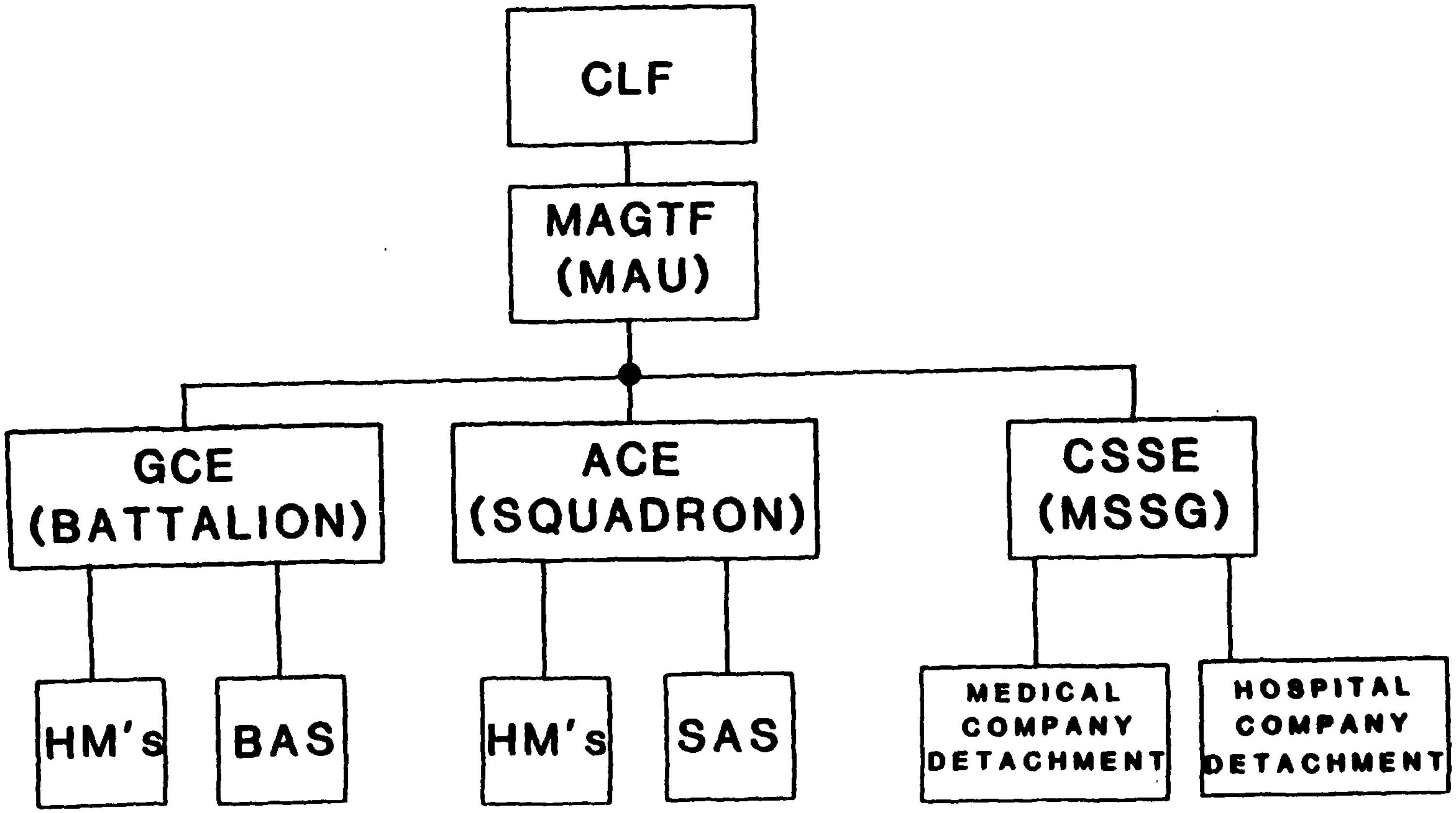

FIGURE 2. MAU COMMAND STRUCTURE

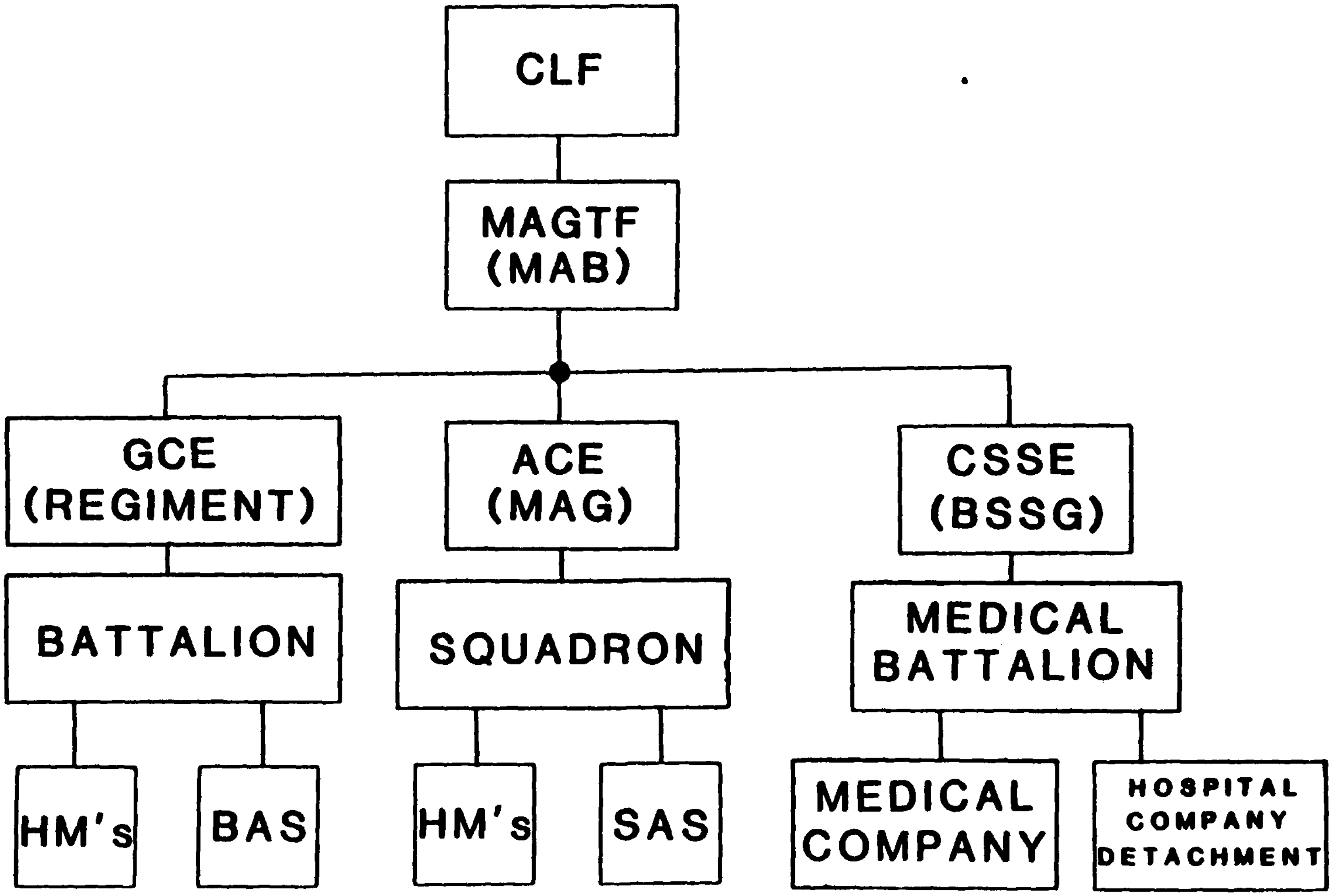

FIGURE 3. MAB COMMAND STRUCTURE

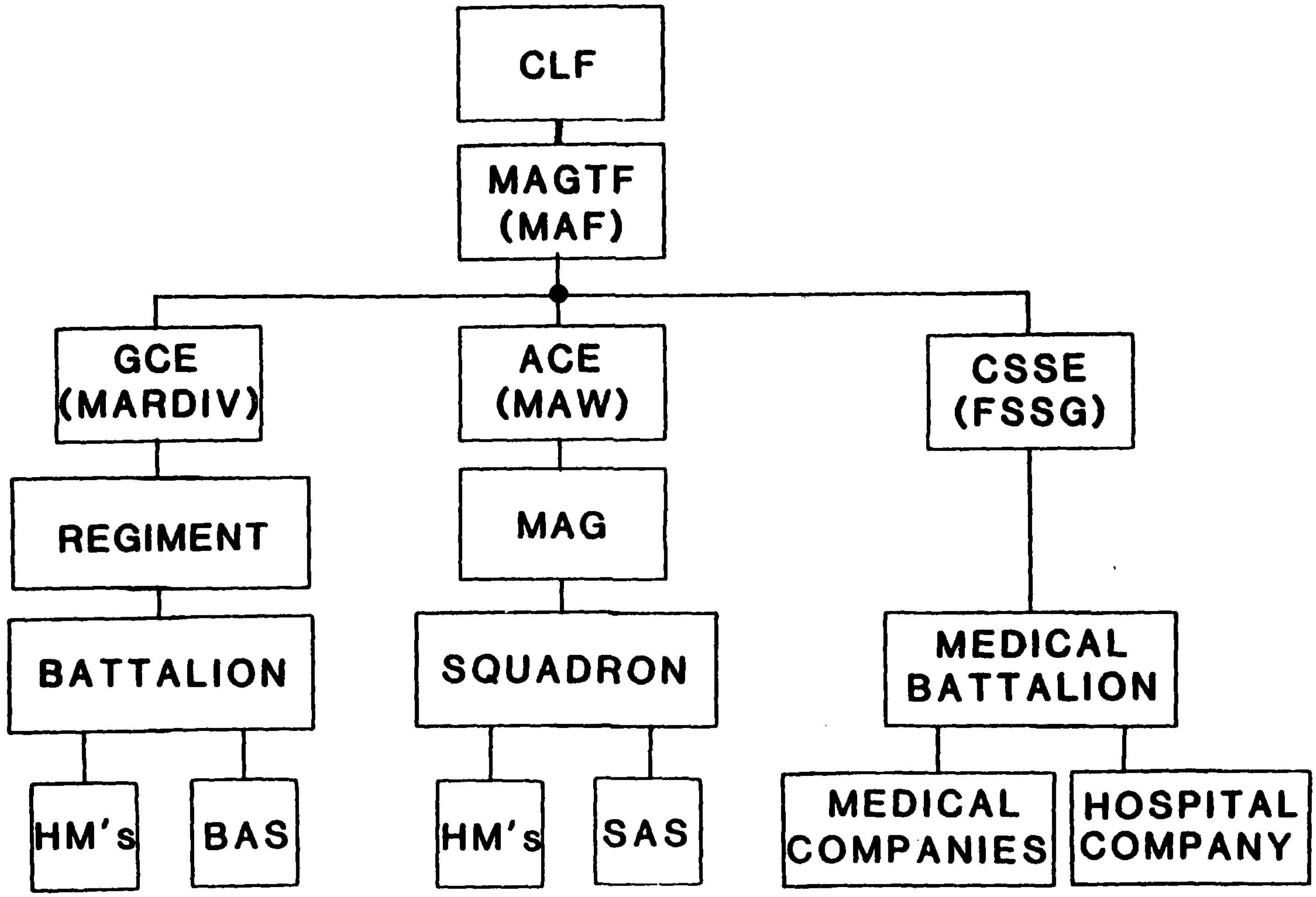

FIGURE 4. MAF COMMAND STRUCTURE

MAGTF OPERATIONS

MAGTF operations consist of two main parts: the first part, the amphibious operations, can consist of:

1. An Amphibious Assault with the following phases
    a. planning
    b. embarkation
    c. rehearsals
    d. movement to the objective area
    e. preassault operations, and
    f. assault
2. An Amphibious Withdrawal
3. An Amphibious Demonstration, and
4. An Amphibious Raid

and the subsequent land operations which consist of:

1. Offensive Operations with the following phases:
    a. advance to contact
    b. attack (from contact through the objective to consolidation and reorganization), and
    c. exploitation and pursuit
2. Defense Operations.

Therefore, MAGTF operations will begin with the planning phase of the amphibious operations and continue through to the exploitation and pursuit phase of the land operations.

The U.S. Army's Air/Land Battle doctrine and the U.S. Marine Corps MAGTF doctrine is based on the expectation that future battles will be finished in a matter of hours, as opposed to the more traditional battle lengths being a matter of weeks. Another projected feature of future battles is the non-linear battlefield. Also, it is projected that the depth of the battlefield in future battles is such that operations against the enemy will be conducted simultaneously from his forward echelons to his rear echelons, as opposed to the more traditional battles taking place primarily in the forward echelons.

The Soviet philosophy of land warfare is to advance with armor and mechanized infantry at about 20 m.p.h. across the terrain until they make contact with their enemy and then to defeat him quickly, hopefully in a matter of hours. Along with this philosophy is the threat that the Soviets will conduct nuclear, biological, and chemical (NBC) warfare when it is to their advantage to do this. This NBC warfare will obviously cause mass casualties which will completely overwhelm the U.S. MAGTF's medical elements, if the medical elements' functions are performed as they presently are.

The capabilities of both the U.S. and Soviet future weapons, for example, their longer-range, greater lethality, improved sophistication, etc. will also be a major factor in the future conduct of warfare. The synergistic effect of all these factors will dramatically change the complexion of future battles and, in particular, will make great demands on the medical systems. A significant alleviation to this battlefield state of the medical systems (in particular the U.S. Marine Corps (USMC) Health Services) can be accomplished through streamlining and making their operations more flexible). One key to this alleviation is to improve the USMC Health Service Communication Systems.

All MAGTF units must "pull together" to achieve the common objective. There are many different types of operations and combinations of operations that are a part of any particular battle. Each operation has certain requirements that have to be fulfilled in order for the operation to be a success and to be executed as smoothly as possible. The probability that these requirements will be fulfilled can be significantly increased if the right types and amounts of personnel, equipment and supplies are present at the right time and place for the right duration. In harmony with this, the right procedures and/or tactics must be applied by these personnel, as appropriate, to the present and upcoming battlefield situations.

MAGTF Medical System

The MAGTF medical system must fulfill all the medical requirements of the present and future battles. The application of the lessons learned from previous battles can lay the foundation for the building of an optimum medical system, with an optimum operation and integration of all its parts, in particular its communications. This entails optimum medical unit (e.g., BAS) oper-

ation along with optimum communication and transportation between the medical units and other associated units.

The medical system will be required to apply all the same principles that the MAGTF combat elements do, in order to be continuously effective, in any operation or transition between operations, in an efficient and economical way. This includes developing medical procedures and/or tactics that are harmonious with MAGTF combat element tactics. This also includes obtaining intelligence information of the military situation that in turn implies the medical need.

The medical logistic implications of this are that we can do such things as base our medical resupply on the amount of supplies left, the rate of usage, and time required to get supplies (or functions performed) from where they are to where they will be used, plus the time it takes to start using them. This may require moving supplies and functions closer to the point of need or a "bucket brigade" type of activity. The goal is for supplies and/or support to appear always there, in the most efficient way.

The medical system should be prepared for all possible operations. It should consider all the possible operations and all the transitions from one type of operation to another, and the medical function that will need to be performed. We should consider how the medical capability can meet the medical requirements for each operation and transitions between operations in an optimum way, e.g., in real time, fast, smooth, efficient, and effective. It should conduct cost-benefit and technology-benefit analyses.

Because of the similar requirements of different operations we could group the medical system requirements for these different groupings of operations and, in particular, the medical system communications requirements for each operation. Above all, we need the flexibility to deal with every case at every level. We must adapt our medical plans and resources to the situation to provide optimum medical care, knowing that the intensity, etc., of the medical requirements will vary from operation to operation.

We must keep each medical function operational. Instead of catastrophic failure of the medical system, we must develop degraded modes of operation, temporarily (e.g. during a nuclear attack) or during transitions (e.g. from offense to defense). We must remove any bottlenecks (e.g. by evacuation). We must return casualties to duty or get them where they should be as soon as possible.

Different combat operations are executed simultaneously and in succession. The medical functions must be performed in real time and in parallel with these combat operations. This will require that we conduct parallel and pipeline processing of casualties, assuming the time to perform a particular treatment or procedure is fixed. Along with all the above, we must take steps to minimize the loss of medical personnel and materiel.

All of these medical system requirements can be fulfilled. One of the most likely candidate capabilities that needs to be improved is the medical communications, which will be considered later in this report. One of the most likely candidate capabilities that needs to be developed for the medical system is expert systems.

PRESENT MEDICAL TREATMENT AND EVACUATION CHAIN

During the initial assault stage, medical care ashore is limited primarily to the medical sections organic to the combat units. Medical care for the initial assault forces is provided by the corpsmen who land with a rifle platoon to which they are attached. The first external support is evidenced when the evacuation stations are established by the shore party at each numbered beach or helicopter landing zone. These evacuation stations constitute the evacuation section of the shore party task organization, and are usually formed from an evacuation platoon of a medical company combined with the personnel and equipment of a shock and surgical team from the headquarters and service company of the medical battalion.

The infantry battalion aid stations, personnel, and litter bearers can be divided into two sections with litter bearers attached to the battalion divided between them. The first echelon of the aid station lands with the battalion commander's command group; the second echelon lands with the executive officer's command group. After landing, the first echelon of the aid station sets up ashore. Litter bearers collect wounded and bring them to the aid station. After they are treated, casualties are recorded and evacuated to casualty receiving and treatment ships (CRTS).

When the evacuation section of the shore party lands, it relieves the second echelon of the battalion aid station which displaces forward and consolidates with the advanced echelon of the battalion aid station. Casualties received at the shore evacuation station are triaged and recorded. Those

requiring additional treatment are prepared for evacuation; others are treated and returned to their units.

A buildup of medical facilities for battalions landed by helicopter is usually constrained to a level provided by the shore evacuation station until a linkup with surface assault units is achieved. However, when a delayed junction with ground assault forces is anticipated, or if a logistic support area is established in the landing zone and the tactical situation is fairly stabilized, additional capabilities from the medical battalion may be introduced.

Following the landing of the assault battalions and their supporting evacuation stations, the next significant step in the evacuation system normally coincides with the surface landing of an infantry regimental headquarters. When it is established ashore, beach evacuation teams usually are consolidated under control of the medical company supporting that regiment. In order to channel the flow of casualties and thus facilitate control of evacuation seaward, evacuation sections are similarly consolidated into a single evacuation station. If it is impractical to consolidate these evacuation sections, the senior medical officers present coordinate their activities and consolidate team evacuation reports.

At a time when the tactical situation ashore permits (usually after the establishment of the division command post), the medical support system begins a buildup of significant emergency surgery and temporary hospitalization facilities by establishing the medical company ashore. This provides emergency and resuscitative treatment for patients until they are evacuated. They provide principal treatment for patients with minor illnesses, wounds, and injuries.

Following the establishment of the medical company, the evacuation platoons, landed previously to operate evacuation stations, are consolidated as soon as possible with their parent medical company and operate as a complete unit. At this time, the flow of surface-evacuated casualties from all units is normally diverted to the medical company.

Recognizing that better care and control of patients can be effected by larger facilities, resources of medical companies should be combined with the headquarters and service company to provide battalion level facilities at the earliest possible time. The employment of separate medical companies in the beachhead should normally be utilized only as necessary to achieve adequate

dispersion of facilities, as dictated by the enemy threat and the tactical and physical environment. Medical support for combat units, such as aviation units operating from bases geographically remote from the beachhead, is task organized from the medical battalion and phased ashore as necessary to provide required health care. Providing a suitable airfield is captured and operational, evacuation by fixed-wing aircraft from beachhead to rear areas may begin during this stage.

When the progress of assault units is such that the security of the beachhead is relatively secure, the landing force medical support system moves into a consolidation stage. Consistent with the expected duration of subsequent operations ashore, the medical support objective during this stage is to achieve a level of emergency care and temporary hospitalization capable of operating from a land-based posture essentially independent of sea-based facilities. This objective is achieved by upgrading facilities ashore through consolidation of medical companies, as discussed previously, and the landing of the hospital company of the medical battalion. Since the hospital company is a major link in the chain of evacuation, it should be located in proximity to an airfield where it can receive and transfer casualties by fixed-wing aircraft. It is emphasized that the availability of a suitable airfield for sustained operations by fixed-wing transports is an essential element for the medical support system at this stage.

If a sustained land campaign is envisioned for the MAF, additional medical facilities would normally be provided in or adjacent to the beachhead in the form of an Army hospital or Navy advanced base functional components. It should be recognized that the phased buildup ashore described above provides only a general outline of the sequence. There are multiple narrations for timing the threat, tactical mission, geography, relative progress of the assault, and availability of other medical installations in the area.

CONCEPT OF MEDICAL REGULATING

General

An amphibious assault is a dynamic movement of personnel and equipment from ships to shore in a time dependent on the tactical situation ashore. Medical support for combat casualties generated by the tactical situation is initially the responsibility of the Commander Amphibious Task Force (CATF). As the amphibious assault progresses, landing force medical units will be

phased ashore. Initially, the Battalion Aid Stations (BASs) will move ashore in designated waves with their battalions. As the Landing Force Support Party (LFSP) phases ashore, and depending on the operation order (OPORD), a Beach Evacuation Station (BES) will be established. As the beachhead is secured, the medical companies may be phased ashore. Prior to the establishment of the medical companies, the coordination of surgical care of casualties remains with the CATF. Once the Landing Force is established ashore, coordination responsibilities will be passed from the CATF to the Commander, Landing Force (CLF). The CATF will continue to provide medical support as long as the Amphibious Operating Area (AOA) exists. Medical regulating, likewise, is phased ashore as the amphibious assault progresses. Initially, the responsibility for medical regulating rests with the CATF. As the landing force is established ashore, the responsibility for medical regulating passes to the landing force. Therefore, a single system of managing the movement of casualties for both the ATF and the landing force is imperative.

Concept of Medical Regulating

The concept of medical regulating is the controlled rearward movement of combat casualties from the site of injury, through the forward medical facilities, to a medical treatment facility within the AOA. Controlled movement is achieved through teams of specially trained personnel accounting for the number and types of casualties and influencing their destination. The influencing of the destination of the casualites is achieved by the Medical Regulating Center (MRC), which is collocated with the movement control agency designated by the ATF or the landing force, and advises these agencies of the preferred destination of the casualties. The preferred destination of the casualties is decided by the MRCC based upon the input received from the Medical Regulating Teams/Sections (MRT/S) located at each medical treatment facility, who report their present casualty load, capacity, and medical/surgical capability. The input from the medical treatment facilities is provided by the trained medical regulators following a systematic reporting system, encrypted, and reported over a non-secure voice radio net. The Medical Regulating Team (MRT) and the MRCC utilize the same radio net which is designated as the Medical Regulating Net. Each MRT continuously updates the MRCC of their status. Each MRT continuously monitors the radio net and maintains a Spot Status Board which provides information on each medical treatment facili-

ty. Although the Medical Regulating Control Officer (MRCO) within the MRC does not have direct control of the air or surface vehicles, the MRCO can advise the appropriate controlling agency as to which medical treatment facility can best handle the combat casualties being evacuated based on the information on the Spot Status Board.

OPERATION OF THE MEDICAL REGULATING SYSTEM

Casualty Movement During the Initial Assault

During the initial assault, casualties are not regulated from the beach or Helicopter Landing Zone (HLZ) to the ATF. Casualties will be placed aboard helicopters/landing craft by their unit corpsmen after First Aid has been administered and returned to the ship from which the vehicle is scheduled to get its next load of troops/supplies. Because these vehicles have a dedicated tactical mission, they cannot routinely be diverted for medical missions. The vehicle will report to its movement control agency the number, type, and, if possible classification of the casualties on board. The MRT/S located with the Primary Control Ship/Helicopter Direction Center/Helicopter Coordination Section/Direct Air Support Center (PCS/HDC/HCS/DASC) will notify the ships receiving the vehicle of the impending receipt of casualties. After the casualties are received and triaged, those requiring movement to another Casualty Receiving and Treatment Ship (CRTS) will be reported by the onboard MRT (see Figure 5) to the MRC for transfer. The MRC will arrange an inter-ship transfer by medical boar or helicopter as available.

Medical Regulating in the Ship-to-Shore Movement

1. Casualites from the scheduled waves may enter the evacuation chain by landing craft or helicopters returning with those casualties suffered in the craft during its movement ashore or immediately adjacent to it on landing. The ATF MRCO may not be involved in the distribution of these casualties, because the requirement to maintain the planned departure of scheduled waves is paramount. The crafts will return to the ship from which they are to get their next scheduled load. As assets become available, lateral transfer of casualties between ships can be effected. When an MRT arrives on the beach, regulating of casualties in boats will begin. Regulating of helicopters will begin as soon as the tactical situation allows.

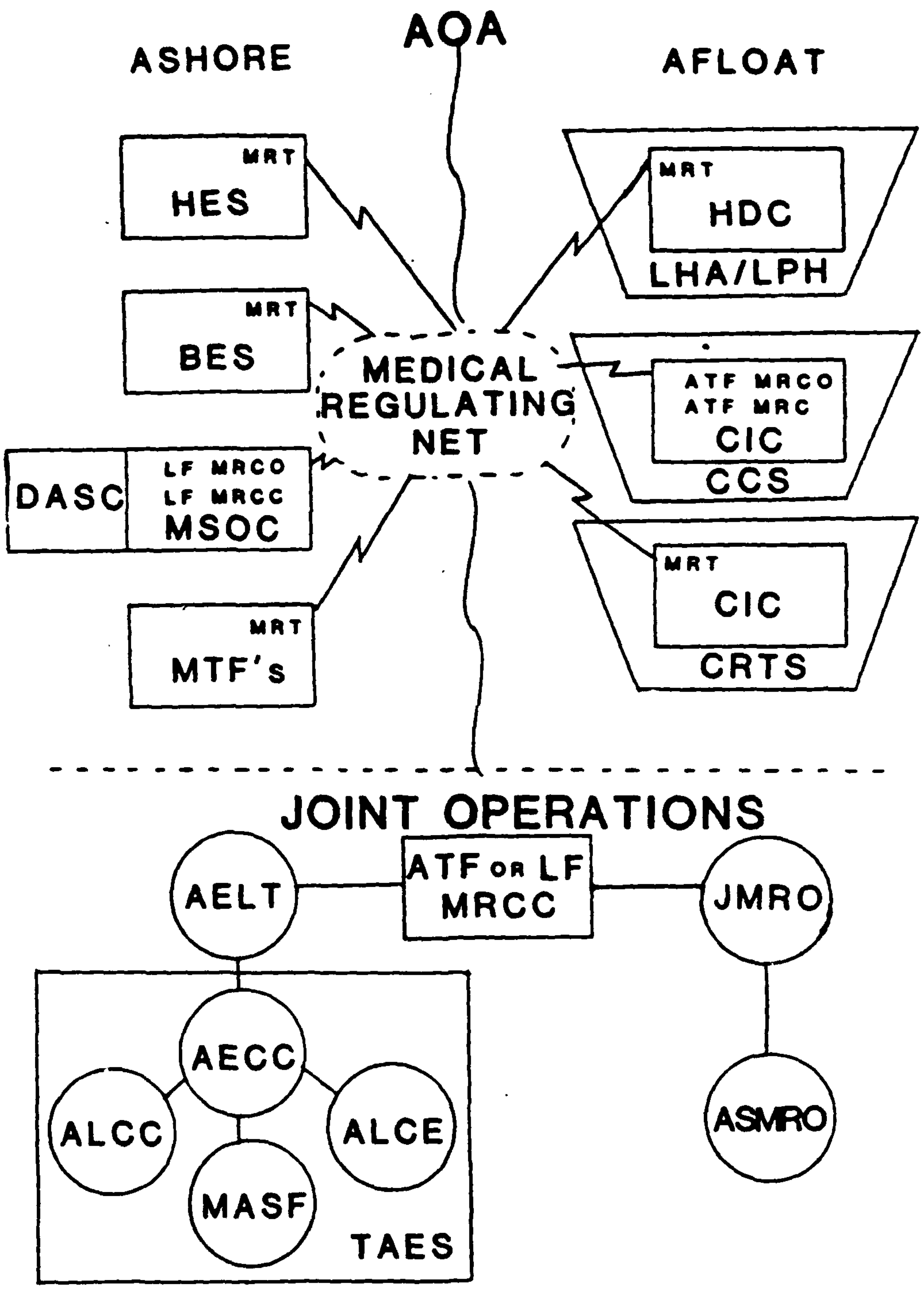

FIGURE 5. MEDICAL REGULATING SYSTEM

2. The CRTS will submit an initial capability/Spot Status Report as directed in the ATF OPORD and thereafter as capability is diminished, and upon recovery from a degraded capability.

3. The ATF MRCO, located with the Task Force Medical Regulating Control Center on board the CATF flagship, coordinates medical regulating throughout the task force and is net control on the Medical Regulating Net. All ATF ships will guard the Medical Regulating Net, and the medical regulators on-board the PCS and the ship functioning as HDC/HCS will be on the net.

a. The ATF MRCO maintains a master Medical Treatment Facilities Spot Status Board with current information based on the Spot Status Reports from the MRTs. The alternate MRCO and all other stations maintain a similar board.

b. When a helicopter/landing craft reports that he is inbound with casualties, the MRT advises HCS/HDC/PCS of the preferred primary and alternate CRTS destination for the casualties based on the information obtained from his status board and/or as provided by the MRCO.

c. The ATF MRCO passes the medical regulating advisory responsibility and net control to a predesignated MRCC or the alternate MRCC if he is unable to control the medical regulating functions.

Casualties Suffered Ashore

1. Forward of the nearest BAS, walking-wounded, as well as surface evacuation vehicles, will operate independently of any guidance from the ATF/LF MRCO. The walking-wounded will follow the line of drift and the vehicles should be permitted to proceed to the nearest BAS on or close to their return route. The philosophy is that it is less traumatic to the casualty if the vehicle is allowed to proceed to the closest medical facility, even if that facility is overloaded.

a. If the casualty's condition is such that he is in need of emergency or urgent care and the medical facility cannot provide such care because of its limited capabilities or because it is overloaded, helicopter evacuation can be requested from the point over the Tactical Air Request Net (TAR Net). In the case of overload, triage will determine which casualties will be given the immediate care at the facility and which casualties will be given deferred care. The "Triage" section at the end of Part I, contains a listing of the casualty classifications to be used within the Atlantic and Pacific Commands and when operating in the North Atlantic Treaty Organization (NATO).

b. If further evacuation to the rear is indicated but there is no need for helicopter evacuation, the movement of such casualties may be accomplished by ambulance or other tactical vehicles. In this case, the evacuation destination will be the nearest Medical Treatment Facility (MTF). Transportation to an overloaded MTF should not be of great concern because patients evacuated from forward medical facilities by ambulance should only be those casualties who require no immediate or urgent treatment. Triage at the MTF will determine if any of the casualties so evacuated deteriorate during the course of the movement and should receive urgent or immediate treatment.

c. Surface evacuation seaward from the BES is under the cognizance of the controlling MRCO. Dedicated medical boats or landing craft are requested from the Beachmaster via the LFSP in accordance with standard procedures. These boats report the numbers and types of casualties embarked to the PCS. The MRT collocated with the Combat Information Center (CIC) aboard the PCS recommends a CRTS. The boats may then be diverted to an appropriate CRTS. The MRT then advises the CRTS and all other stations on the Medical Regulating net of the destination.

d. As in the case ashore, casualties requiring immediate or urgent care should not have been evacuated by surface means, unless there are no available helicopter assets. Therefore, the reception of casualties who are of a routine nature at an overloaded facility is not of great consequence. During the early stages of the assault, the landing craft may evacuate casualties of the immediate or urgent type to a CRTS that does not have the appropriate capability to provide treatment for such casualties. In such cases, the CRTS will submit a Spot Status Report and request lateral evacuation from the ATF MRCO over the Medical Regulating Net. The ATF MRCO advises HCS/HDC or the appropriate MRT of the request and at the same time, if feasible, gives the preferred primary and secondary destinations. By triage at each stage of evacuation casualties will be sorted out for retention and those whose conditions require will be sent onward by helicopter/landing craft.

e. If the BES requires a helicopter for evacuation of patients who should not proceed by surface means, the BES advises the Shore Party Team Leader who, by coming up on the Helicopter Request Net, can request a helicopter. The Shore Party Team Leader will, if he is unsuccessful in the above procedure, direct the BES to contact either an ATF MRT if control is still

afloat, or the LF MRT, as applicable. One of these agencies can then pass the requirement to the appropriate helicopter control agency.

f. For helicopter evacuation during the assault phase, medical regulators hearing the number and type of casualties advise the HCS/HDC of the preferred primary and secondary destinations of the casualties, depending on the relative status of the CRTSs. The tactical movement ashore or the need to refuel may necessitate HDC to direct the helicopter to a different ship.

g. The ATF MRCO will make an appropriate tag on his master status board that casualties have been directed to a particular CRTS but will not change his figures until receiving an updated Spot Status report from the CRTS.

h. If the ATF MRCO receives no report of receipt within 30 minutes, he assumes they arrived and he removes the tag from his master board and updates the bed status accordingly.

i. On receipt of the casualties, Sickbay will triage the casualties, determine the level of care required, and determine if an overload situation exists. Sickbay notifies the MRT of the arrival of the casualties, if an overload exists, and why. The MRT will send a Spot Status Report to the MRCC only if an overload occurs. The new casualty figures will be included in the next scheduled update of the Spot Status Board.

j. Surface evacuation from helicopter landing zones and sites will not be attempted until there has been a linkup of the ground elements. Surface evacuation within the area of responsibility of the heliborne force to the supporting Helicopter Support Team (HST) will not be subject to medical regulating efforts.

Medical Regulating During Operations Ashore

1. As each LF MTF is established, it submits an initial Spot Status report to the ATF MRCC via the Medical Regulating Net. Thereafter each MTF submits a Spot Status Report when one of the conditions causing diminished capability occurs, as scheduled in the OPORD or as requested by the MRCC.

2. The LF MRCC lands with the DASC and becomes ready to assume the medical regulating advisory functions when DASC assumes control of helicopters ashore. LF MRCC will assume net control and medical regulating responsibilities when CLF formally assumes medical regulating ashore.

a. The LF MRCO requests a current MTF Spot Status Report from the ATF MRCO. Thereafter, he maintains the Master MTF Spot Status Board with information based on subsequent reports of the MRT(s) located ashore and afloat.

b. The LF MRCC guards the Helicopter Request (HR) Net and advises DASC of the preferred primary and alternate LF MTF destinations based on the information of the master status board. The LF MRCO will not normally attempt to distribute the casualties aboard one helicopter to two or more MTFs. If the LF MTFs are incapable of providing the indicated care, as the helicopter picks up the casualties the LF MRCO will advise the DASC that the casualties should be taken seaward if possible, and if not possible, the LF MRCO will give a desired and alternate MTF ashore to DASC. If the LF MTFs are incapable of providing the indicated care, the LF MRCO should advise DASC that the casualties should be taken to afloat facilities and then inform the ATF MRCO via the Medical Regulating Net.

3. Upon CLF formally assuming medical regulating responsibilities ashore, the ATF MRCC and MRTs will continue to guard the Medical Regulating Net and be prepared to advise HCS/HDC or PCS or the preferred and alternate destinations of casualties referred seaward by the LF MRCO. To preserve a desired degree of flexibility ashore, and to accommodate the reception of surface transported casualties ashore, the LF MRCO will not normally permit an occupied bed rate above 50% among the LF MTF and will regulate casualties accordingly. He should also regulate casualties from one MTF to another when future combat actions are planned in a specific area/section. LF MTFs must remain highly mobile and capable of responding on short notice to changes in the tactical situation.

Evacuating Patients Out of the AOA

1. Current policy states that the movement of patients in the Armed Forces will be by air, and that the Military Airlift Command (MAC) has the mission of establishing inter-theater and intra-theater aeromedical evacuation systems during joint operations. These systems will include the provision of Mobile Aeromedical Staging Facilities (MASF) as required on or in the vicinity of fixed-wing capable fields for entering patients originating in the combat zone who are medically regulated to medical facilities located elsewhere in the theater and beyond. The higher headquarters plan under which the ATF and the LF are operating will task the appropriate commander with establishing the

fixed-wing aeromedical evacuation system and also will provide for the implementation of worldwide aeromedical evacuation. In operations involving only Navy department forces, the Navy is responsible for providing in-theater and out-of-theater evacuation.

2. The normal role of the ATF/LF MRCC in evacuating patients out of the combat zone is:

a. The ATF MRCO reports to the Joint Medical Regulating Office (JMRO) by message or phone the casualties in the CRTS whose conditions will place them beyond the local evacuation policy and who can tolerate evacuation.

b. The LF MRCC reports to JMRO the casualties in the LF MTF whose conditions will place them beyond the local evacuation policy and who can tolerate evacuation.

c. Utilizing the information provided by the MRCC, the JMRO will initiate a request to the Armed Services Medical Regulating Office (ASMRO) for evacuation to CONUS. For inter-theater evacuation the JMRO will designate the receiving hospital.

d. Upon notification by JMRO that casualties are to be transferred to the MASF, the MRCC will request transportation from their respective helicopter control agency, if indicated, and notify their respective MTF of the patients to be moved and the time of arrival of the helicopter. If the patients can be moved to the MASF by ambulance from one or more of the LF MTFs, the LF MRCC will request the MRT at the facility to arrange ambulance transportation. When necessary the MRCCs will coordinate boat and ambulance transport for ATF ships.

e. The ATF/LF MRCC will not attempt to perform the functions relating to medical regulating of casualties to destinations out of the combat zone unless no JMRO is established and the OPORD directs them to do so.

3. Occasionally the evacuation of casualties from the MASF will not occur as planned, and due to its limited capability, the casualties might be returned temporarily to the MTF. In such cases, the MASF will notify the appropriate MRCC to recover the casualties and place them in appropriate facilities until evacuation again becomes possible. Helicopter and/or ambulance transportation of casualties may be indicated and arranged. If practical, these

casualties should be retained ashore since they normally will be evacuated out of this area.

4. If there is no request to recover the casualties from the MASF by the time of the scheduled departure of the evacuation flight, the ATF MRCO and/or the LF MRCO will request the CRTS and the LF MTF to submit a current Spot Status Report for the purpose of updating the master boards.

5. Specific tasking and coordinating instructions for medical regulating of casualties out of the AOA, will be reflected in the OPORD or Operation Plan (OPLAN).

Tactical Aeromedical Evacuation System (TAES)

1. Tactical (in-theater) aeromedical evacuation is a responsibility of the MAC in coordination with the Air Force commander. In the Commander in Chief, Atlantic's (CINCLANT's) AOR, the Commander in Chief of the Atlantic Air Force (CINCAFLANT) operates the TAES through the 1st Aeromedical Evacuation Squadron (1st AES) located at Pope Air Force Base, North Carolina. In addition to the 1st AES, the 2nd AES supports Europe and the 9th AES supports the Pacific area. The CATF or CLF requests the assignment of TAES elements from the United States Air Force (USAF) commander, via the chain of command.

2. TAES is a highly mobile system and consists of USAF medical personnel and equipment that can be deployed to a combat zone to expedite the evacuation of casualties. In its deployed form, TAES consists of four elements:

a. The Aeromedical Evacuation Control Center (AECC) is the command and control element and coordinates the activities of the other elements. The AECC coordinates with the tactical aircraft agencies the Airlift Control Center (ALCC) or Airlift Control Element (ALCE) for the selection and scheduling of aircraft for evacuation. The AECC is normally located with the ALCC/ALCE. Support personnel organic to the AECC are responsible for maintaining their own supplies and equipment. Resupply items are obtained from local military sources to the extent possible or USAF sources.

b. The MASF is an air transportable, temporary casualty staging facility located at the AOA fixed-wing capable airfield. The MASF operates under control of the AECC. The MASF provides temporary (4-6 hours) holding of

casualties, completes administrative processing, provides supportive medical care, configures aircraft to receive casualties, loads the casualties, and provides corpsmen and nurses to crew the airlift. The MASF can hold 25 casualties at a time and up to 100 per day. If a physician is required to accompany a casualty he is provided by the ATF/LF Surgeon since the MASF is staffed only by corpsmen/nurses. Specialized equipment will be provided by the sending MTF as well as casualty transportation to the MASF. The MASF will be dependent on the host command for ground transportation, fuel, food, shelter, and security, since by organization it has none.

c. The Aeromedical Evacuation Liaison Team (AELT) provides a direct link and coordination between the MRCC and TAES. The AELT coordinates with the MRCO concerning the origin and destination of casualties. The AELT will brief the MRCC and the MTF/CRTS, ensuring that they are fully aware of the mission, capabilities, limitations and dispositions of the TAES. The physician at the MTF/CRTS certifies the casualty suitable for evacuation establishes movement precedence (Urgent, Priority, Routine) and prescribes any en-route care. The AELT will coordinate with the MTF/CRTS the transfer of casualties to the MASF and with the AECC for aircraft. The team will monitor the tactical situation and advise the AECC on significant events; they will also monitor the TAES radio system and keep the MRCC informed of any problems affecting evacuations.

d. Aeromedical evacuation crews provide en-route care aboard the tactical aircraft. They follow medical care procedures prescribed by the MTF/CRTS physician. The crew normally consists of one nurse and two corpsmen. There are no physicians assigned to TAES.

3. The primary aircraft used for tactical aeromedical evacuations are the C-130 and C-141.

Joint Medical Regulating Office (JMRO)

1. The JMRO is established by the area Commander-in-Chief (CINC) to facilitate evacuation of casualties from within a theater of operations. When established, the JMRO will regulate the movement of sick and wounded personnel by:

a. Maintaining direct liaison with ASMRO, the medical regulating elements of component commands, the transportation agencies which furnish the evacuation transportation, and the component command surgeons.

b. Developing and recommending to the command surgeon overall policies, procedures, and guidance for reporting medical evacuation requirements within the command.

c. Consolidating and disseminating current and projected estimates for patient evacuation requirements.

d. Providing advice to the command surgeon on those portions of the joint operation that relate to patient evacuation.

e. Obtaining reports of available beds, by type, from component fixed medical commands using the daily medical status report.

f. Utilizing the daily medical status reports to prepare the request for CONUS hospital destination on a daily basis from ASMRO, Scott Air Force Base, Illinois. ASMRO will report back to the JMRO with the designated medical treatment facilities for evacuation.

2. The MRCC established by CATF/CLF will consolidate requests for tactical aeromedical evacuations from their subordinate units and notify JMRO by message. The establishing directive and OPORD from the CINC will provide appropriate guidance on reporting formats and requirements. Normally the report will identify casualties using the eleven classifications utilized by ASMRO as either litter or walking (ambulatory).

3. On receipt of the request for movement, the JMRO will determine the availability of in-theater hospital care. If required, JMRO will consult with ASMRO for designation of hospital beds in the Continental United States (CONUS). Once a destination has been determined, JMRO will notify the MRCC (by telephone, radio, message). The MRCC will contact the AECC through the AELT for evacuation aircraft.

4. The MRCC will identify their evacuation requirements and the priority of the request to the AEC. The movement precedence will be identified as either Urgent, Priority or Routine. These classifications relate to the time delay between receipt of the request at the AECC and the time of pickup of the casualties. During an amphibious operation, out of AOA evacuations will not

begin until a fixed-wing airfield is secured, normally after D+5 (5 days after D-Day). Therefore, the patient movement classification must take into consideration these tactical delays. Under ideal conditions the following time restrictions will apply by classification unless reduced by the CINC Air Forces Commander:

a. Urgent. For an emergency case which must be moved immediately to save life or limb, or to prevent complication of a serious illness. Psychiatric or terminal cases with a very short life expectancy are not considered urgent.

b. Priority. For patients requiring prompt medical care not available locally. Such patients must be picked up within 24 hours and delivered with the least possible delay.

c. Routine. For patients who should be picked up within 72 hours and moved on routine or scheduled flights.

Armed Services Medical Regulating Office:

a. ASMRO located at Scott Air Force Base, Illinois is a joint service organization under DOD, tasked with providing effective control over medical regulating and to ensure effective utilization of available hospital beds and medical specialty care.

b. CONUS based MTFs report medical capabilities to ASMRO, who in turn will route returning casualties identified by JMRO to those facilities able to provide an appropriate level of care. ASMRO will distribute patients to the nearest MTF unless it is expected the patient may not return to duty, in which case the patient is sent to a facility near his home.

c. In the event no JMRO is established in a theater, the MRCC will contact the ASMRO directly for designation of a CONUS hospital bed. The information normally provided by JMRO will be provided by ASMRO.

MEDICAL REGULATING PRINCIPLES, RESPONSIBILITIES AND PLANNING

Principles

General

1. In order for medical regulating to be effective, the number and type of casualties in the medical evacuation chain must be reported to the MRCC.

2. The medical regulating system is not intended to be used as a statistical gathering agency nor as a means of monitoring individual casualty progress.

3. Medical regulating will be conducted on the principle of obtaining benefits for many casualties vice individuals. For example, a vehicle full of general surgery and orthopedic casualties requiring urgent surgery and one brain casualty requiring urgent surgery would not be regulated to a MTF having a neurosurgeon if the facility already has a surgical backlog and other facilities without a neurosurgeon have no backlog; the latter would be the recommended destination. There will be no attempt to regulate casualties in one helicopter or boat to more than one destination.

4. There will be no attempt to regulate land vehicles evacuating casualties or walking wounded forward of the most forward surgical facilities.

5. All helicopter pilots and boat coxswains picking up casualties, whether or not primarily on a medical evacuation mission, will report to their control agency, as soon as practicable, the number of litter casualties, walking wounded and, when possible, the type and condition of the casualties.

6. In the conduct of medical regulating, medical regulators do not normally talk with the helicopter pilots or boat coxswains.

7. The medical regulating system is not a substitute for, nor a complement to, the casualty reporting process. Casualty reports will be submitted in accordance with the Marine Corps Casualty Procedures Manual.

8. The ATF MRCC, the LF MRCC, the MRT collocated with the HDC or PCS, and the ATF/LF alternate MRCC must all be able to monitor the nets over which helicopter or landing craft medical evacuation is being requested. Normally, this can be accomplished by making dedicated spaces within the movement control agency available to the regulators.

9. In the assault phase, casualties occurring in a helicopter or placed in a helicopter after it touches down in the HLZ will normally be taken to the ship to which the HDC directs it for its next load or for refueling. Casualties can be laterally moved to a CRTS if required by the MRCC. The same procedures apply to casualties occurring in landing craft during the assault.

10. Mass casualty situations, in contrast to casualty overload, render the formal medical regulating system inoperative. Soon after a mass casualty situation occurs, all local medical facilities become so greatly overloaded that attempts at immediate casualty regulation are completely thwarted. The initial effort should be to clear and organize the areas in which the mass casualties occurred and then to move the casualties out of those areas by the most expeditious means. This rapid evacuation can very quickly supersaturate all rearward medical facilities. The medical regulating system should not be considered as the prime method of alleviating the pressures of mass casualty events.

Principles Common to the Amphibious Task Force and the Landing Force.

1. A CRTS or LF MTF will normally be considered to have an overload situation when:

a. it has a backlog for major surgical cases totaling more than six hours (when heavy casualties are being sustained this may have to be lengthened);

b. more than 80% of the operating beds are filled with casualties requiring medical attention by medical personnel; and

c. there is a decrease in capability because of

(1) fatigue or other loss of medical personnel.

(2) inadequate supplies.

(3) inadequate blood products.

2. When one or more of the above conditions exist, the unit will immediately submit, over the Medical Regulating Net, a Medical Treatment Facility Spot Status Report (Spot Rep).

3. The CRTS/MTF will submit logistics or administrative requests through established command lines to secure the personnel, equipment and supplies necessary to resolve the situation. The Medical Regulating Net is never used for this purpose. The only logistics transmissions authorized over the medical net are requests for shipments of whole blood and blood products from the ATF to a LF MTF.

Principles of Concern to the ATF

1. The MRCO will coordinate medical regulation in the AOA through the MRS collocated with HDC, PCS, and other designated agencies in the casualty evacuation system. The MRCO will keep himself and the CATF Surgeon apprised of medical capabilities in the AOA, will be aware of tactical/operational conditions affecting the evacuation and medical regulating system, and will direct and advise the MRT accordingly. In pursuing the aforementioned, the MRCO will establish close liaison with appropriate staff sections and the LF MRCO.

2. The ATF medical regulating personnel will not attempt the regulating of casualties among the MTFs except as directed by the MRCO.

Principles of Concern to the LF

1. The LF MRCO is embarked on the same ship as the DASC, lands in the same serial, and is collocated ashore or contiguous to the DASC. He will have instant and reliable intercommunication with the DASC when not located within the same facility.

2. An alternate LF MRCC is embarked on the same ship as the agency that will function as the alternate DASC, lands in the same serial, and is collocated ashore or contiguous with that agency. If not collocated with the alternate DASC, he will have instant and reliable intercommunication with that agency.

3. The LF MRCO will formally request to assume medical regulating responsibilities from the CATF MRCO. Once control is passed ashore, the CATF MRCO requests the MTF and CRTSs to update the Spot Status Boards; thereafter, the LF MRCO will maintain his master status board based on spot reports from the

MTF and CRTSs. Normally, this occurs when control passes from HDC to DASC and LF MTFs are established ashore.

4. On establishing ashore, the LF MTF will submit an initial report of its capability to the MRCC.

5. Each BES will have a hotline to the Beach Party Team Leader over which requests for landing craft are coordinated. The Beach Party Team Leader will coordinate with the Navy Beach Masters the staging and loading of casualties.

6. The BES will request helicopter evacuation when the condition of a casualty reaching the beach warrants helicopter vice surface evacuation. This request is made to the Shore Party Team Commander who requests the evacuation over the TAR Net.

Principles Involved in Evacuation of Casualties out of the Combat Zone or out of the Theater

1. Except in the case of a mass casualty situation or casualty overload, casualties will be stabilized before being reported ready for evacuation out of theater.

Responsibilities

General

The considerations that govern responsibilities for any amphibious operation apply to the medical regulating system. These responsibilities roughly parallel those governing the control of air operations as defined in the current edition of NWP 22-B/LFM 01.

Specific Responsibilities

The CATF is responsible for the preparation of the overall plan for the conduct of medical regulating within the AOA and for the entering of the combat casualty into the medical regulating system. Specific responsibilities are as follows:

1. CATF

   a. Ensure the ATF OPORD addresses medical regulating in sufficient detail to be conducted and supported by personnel and resources assigned to the ATF.

b. Ensure the communications plan satisfies the requirements of the medical regulating system with respect to the establishment and functioning of the Medical Regulating Net and for the conduct of medical regulating among the ships of the ATF.

c. Ensure the air plan contains provisions to satisfy the requirement for a MRS to be collocated with the ATF helicopter primary and/or alternate control agencies (i.e. HDC).

d. Control medical regulating until these functions are formally passed ashore to the CLF.

e. Determine the need for and request the augmentation of personnel to provide medical regulating services on each CRTS.

f. Ensure the ATF OPORD contains provisions to satisfy the requirement for a Medical Regulating Team to be aboard the PCS.

g. Request from higher headquarters augmentation by a USAF AELT and a MASF to coordinate out of AOA evacuations once an air field is secured.

2. CLF

a. Ensure the medical appendix (appendix 3 to Annex D) of the LF OPORD addresses the medical regulating system in sufficient detail so medical regulations can be controlled by the LF MRCO and the AMRCO when control is passed to the LF.

b. Ensure the communications plan (Annex K) satisfies the requirements of the medical regulating system in respect to the establishment and functioning of the Medical Regulating Net.

c. Ensure the air plan (Annex N) contains provisions for the LF MRCO and the alternate MRCO to be collocated with the LF primary and alternate DASC.

d. Ensure the embarkation appendix embarks the LF MRCC and an alternate MRCC with the DASC and alternate DASC respectively.

e. Ensure there is an MRT at each MTF ashore, that they are embarked on the same ship as the MTF supported, and that it lands in the same serial.

f. Since medical units forward of the medical companies are not involved in medical regulating, the command post for the Landing Force should alert the MRCC of any large number of casualties being evacuated from the forward areas.

Duties, Special Staff, and Subordinate Commanders

1. CATF SURGEON

a. Ensures that, within his organization, the OPORD/OPLAN adequately provides for the proper functioning of medical regulating.

b. Ensures that all members of the ATF MRS understand and appreciate the concept and the proper procedures to be employed in the efficient functioning of the system.

c. Coordinates with USN Operations (N-3) for Medical Mobilization Augmentation Readiness Team (M-MART) regulators for logistic support and for the location of the afloat helicopter and small boat control agencies, with the ships for medical regulating augmentees, with the USN Logistics (N-4), and with the Communications Officer for all aspects of communications.

d. Presents his requirements in writing to appropriate staff officers.

e. Monitors the regulating process in actual operations.

f. Provides the ATF MRCO the information required for the advance planning of medical regulating.

g. Coordinates medical planning with members of adjacent and higher headquarters staffs.

2. LF SURGEON

a. Ensures that, within his organization, the OPORD/OPLAN adequately provides for the proper functioning of the medical regulating process.

b. Ensures that all members of the LF MRS understand and appreciate the concept and the proper procedures to be employed in the efficient functioning of medical regulating.

c. Coordinates with the USMC Operations (G-3) concerning the task organization and landing plan, the USMC Logistics (G-4) for embarkation, the Air Officer for helicopter operations and control, and the Communications-Electronics Officer (CEO) for communications support.

d. Presents his requirements in writing to the appropriate staff members.

e. Monitors the regulating process in actual operations.

f. Provides the LF MRCO with information concerning his advance planning and coordinates with members of the LF, ATF and other headquarters' staffs.

3. COMMANDING GENERAL (CG), FSSG

a. Ensures that all landing force MRT personnel are maintained in a high state of training and readiness.

b. Ensures that sufficient communications, transportation and field equipment is available to support each MRT during operations.

c. Ensures coordination of support requirements is completed with CG MAW for collocation of the LF MRCC with the DASC.

4. ATF AND LF MEDICAL REGULATING OFFICERS

a. After the ATF/LF Surgeons have passed the information concerning their respective advance planning and coordination to the ATF/LF MRCOs, it is the responsibility of the MRCOs to perform the detailed planning with the respective teams to ensure the requirements for medical regulating are satisfied in the various orders.

b. During the conduct of the operation, the MRCOs will:

(1) Keep the ATF/LF Surgeon advised on medical regulating matters.

(2) Monitor the nets over which the landing craft or helicopter medical evacuation is being requested.

(3) Maintain the master Medical Treatment Facility Spot Status Board.

(4) Act as net control for the Medical Regulating Net.

(5) Advise the vehicle movement control agency on the preferred destination of casualties being evacuated.

(6) Notify the intended destination MTF of the impending arrival of casualties and any available information.

5. MEDICAL REGULATING TEAMS

a. General Responsibilities

(1) Guard the Medical Regulating Net as directed by the MRCC.

(2) Receive and transmit (over the net) information regarding medical support capabilities, casualty evacuation status, etc., as directed in the OPORD/OPLAN.

(3) Maintain Spot Status boards as directed by the OPORD/OPLAN.

(4) Be prepared to assume the duties of the MRCC if directed or if the MRCC becomes unresponsive on the net.

(5) Provide the reporting link between both the ATF CRTS and the LF MTF, and the ATF and LF MRCOs.

b. Specific Responsibilities

(1) The MRT aboard the LHA/LPH will advise the HDC of the appropriate CRTS available to receive and provide medical treatment to incoming casualties. Such decisions will take into consideration the medical treatment required and the ship's capability to provide the care.

(2) The MRT aboard the PCS will:

(a) Advise the CIC of the appropriate CRTS to receive casualties being evacuated by boat.

(b) Transmit to the ATF/MRCC, via the Medical Regulating Net, information on all casualties evacuated by boat. Such transmission is to include number of casualties (broken down by litter or walking), destination (i.e. CRTS), and type of wound.

(c) Maintain a Medical Treatment Facility Spot Status Board to reflect the current status of Secondary Casualty Receiving and Treatment Ships (SCRTSs).

(3) When directed, provide an MRT for on-the-scene mass casualty medical regulating duties.

6. VEHICLE MOVEMENT CONTROL AGENCIES

a. The Vehicle Movement Control Agency is that element which directs aircraft or landing craft within the AOA. Most commonly, this agency will be the HDC or the DASC, but also may involve the PCS in the control of landing craft.

b. Direct helicopters or landing craft in response to requests for casualty evacuation.

c. Consider the recommendations of the MRCO in the destination of the casualties being evacuated.

7. MEDICAL BOATS. Report tne number and types of casualties (both litter and walking) to the PCS as directed in the OPORD.

8. HELICOPTER PILOTS. Report the number of casualties (litter and walking) and, if possible, types presently aboard, to the Helicopter Coordination Section (HCS), HDC or DASC as soon as possible after picking up casualties.

9. BEACH EVACUATION STATION.

a. Functions as the collection, triage, emergency treatment and onward evacuation agent for casualties received on the beach.

b. Processes casualties received on the beach from CRTSs who are destined for evacuation out of the AOA and are en route to an MASF at a fixed-wing capable airfield.

c. Establishes positive communication with the Beach Master element of the Navy Control Group on the beach through the LFSP.

10. SHIP'S MEDICAL DEPARTMENT

a. Develops internal procedures to ensure that the information required for the MTF Spot Status Report is provided to the MRT each time there is a change in the report. Ships augmented by M-MART (Surgical) Teams must develop procedures that can support the increased medical regulating function.

b. Initiates any Navy messages required by the OPORD/OPLAN with regard to casualty reporting, evacuation or medical regulating.

c. Provides for liaison between MRT, Sickbay, and any embarked Surgical Team.

d. Establishes direct phone or messenger contact between the MRT and Sickbay to facilitate passing of information in a timely manner.

e. Must be prepared to perform the functions of the MRT if one is not embarked.

f. Informs the on-board Commander of Troops of the name and unit of all landing force casualties held in Sickbay.

11. SHORE PARTY. Contacts helicopter/medical boats for casualty evacuation when requested by an MRT or the BES.

12. SPECIFIC RESPONSIBILITY FOR EVACUATION OUT OF THE AOA. The responsibility for such functions rests with the ASMRO via the JMRO, if established.

Medical Regulating Agencies

1. ORGANIZATION OF THE CATF MRCC.

a. The CATF will exercise command and control over the MRCC through the CATF Surgeon. Staff cognizance of the MRCC is under the CATF Surgeon.

b. The MRCC will be collocated with the CATF surgeon or, if directed, with the Tactical Air Control Center (TACC), HDC, or PCS, depending on the primary evacuation method.

c. MRTs will be located on each CRTS and are subordinate elements of the CATF MRCC.

2. ORGANIZATION OF THE CLF MSOC AND MRCC

a. The CLF MSOC is under the Operational Control (OPCON) of CLF. Staff cognizance is exercised through the CLF Surgeon.

b. The MSOC is collocated with the headquarters of the senior Combat Service Support command of the landing force. The logistical command is tasked with providing support services to the MSOC.

c. The MSOC coordinates, with the Health Services Support Office (HSSO) of the logistics command, the effective utilization and operation of all landing force medical and dental assets.

d. The MSOC has authority to act for the CLF in matters concerning the regulation of casualties and coordination of LF medical assets. The MSOC will refer matters of a policy nature or involving agencies or commands external to the LF to the CLF Surgeon for action. Contact with medical commands of other services or external to the force dealing with routine casualty matters of a non-policy nature is authorized.

e. Subordinate to the MSOC is the MRS and its organic MRT. These teams may be task organized and will be attached to each landing force MTF. The MRS is utilized to staff the LF MRCC when established.

f. The MRCC is collocated with the DASC during operations until such time as the tactical situation and casualty flow may allow it to relocate to the MSOC. The Alternate MRCC (AMRCC) will remain with the alternate DASC or replace the MRCC at the primary DASC. The AMRCC will be prepared to assume control of the medical regulating net should the MRCC be unable to control the net.

Planning

General

1. As in other areas there is a need for coordinated and concurrent planning with respect to casualty destinations. It is essential not only that the officers conducting medical regulating coordinate and consult among themselves

but also that they determine early in the planning phase with their respective staffs the support required from other sections or higher headquarters.

2. Medical regulating is not purely a medical function. In fact, the medical effort, except for the clinical aspects, may be described as a minor part of this evolution. Without support from the sections herein discussed, the control of medical regulating is nonexistent. To ensure that the required support is provided, it is necessary that the OPORD, including applicable appendices, adequately address medical regulating. This is accomplished by the CATF and CLF Surgeons and their MRCOs, each making early and periodic coordination visits with the cognizant officers of the respective ATF and LF staffs, to ensure that provisions are included in the respective plans for the conduct of medical regulating.

Planning Requirements

1. Commander, Amphibious Task Force. The ATF has the responsibility for medical regulating during the early part of an amphibious operation. The initial planning of medical regulating by the CATF Surgeon requires that the planning operation be thoroughly reviewed with interest being directed at the tactical situation, enemy capability, casualty estimate, medical resources available, and the probability of air superiority. Based on this information, medical regulating can be planned.

a. The location of the primary MRCC is dependent upon whether casualty movement will be by air or by medical boats. If helicopters will be the primary mode of transportation for combat casualties, then the MRCC must be collocated with HDC/TACC. If medical boats will be the primary mode of transportation for combat casualties, then the MRCC must be collocated with the control agency for the landing craft aboard the PCS. If the primary mode of transportation for combat casualties will shift during the amphibious operation from medical boats to helicopter, then net control needs to be shifted from the MRCC on the PCS to the MRCC at the HDC at the same time.

b. If there is an alternate PCS or HDC, then there must be an AMRCC. This allows continuity of medical regulating if, for any reason, the primary MRCC ceases to function.

c. An MRT or designated personnel will be assigned to each ship that has a HDC function. The MRT will be collocated with its supporting HDC, and if not in the same space, effective and reliable communications will

be established to ensure that the MRT or designated personnel are provided with current information regarding aeromedical evacuation of casualties.

d. An MRT or medical regulator will be assigned to each ship tasked as a PCS. The MRT will be located within the CIC and if not in the same space, effective and reliable communications will be established to ensure that the MRT is provided current information regarding casualties requiring surface craft evacuation. The MRT will provide recommendations/advice to the PCS staff regarding destination CRTS for casualties requiring medical treatment.

e. An MRT must be assigned to any ship that could possibly receive casualties. If the ship receiving casualties is not equipped to properly care for combat casualties, then the MRCC is notified to arrange for transfer of these casualties to the proper CRTS.

f. The CATF Surgeon must ensure adequate training of all MRTs aboard CATF shipping.

g. The Medical Regulating Net selected in coordination with the Communications Officer must be compatible with the radio nets available to the Landing Force.

h. The lateral movement of casualties from a ship to a CRTS must be coordinated with the MRCC. The lateral movement of casualties can be by helicopter or medical boats, but helicopters are preferred.

2. Landing Force. In conjunction with the CATF staff, the Landing Force staff must coordinate medical regulating to complement the procedures utilized by the CATF. Landing Force medical staff planning will address the same issues as those addressed by CATF. Based on this information and in coordination with the CATF Surgeon, the Landing Force Surgeon will plan medical regulating for the Landing Force and be prepared to assume coordination of medical regulating when control is passed ashore.

a. The Medical Battalion of the FSSG is tasked with the mission of conducting medical regulating for CG Marine Amphibious Force (MAF).

b. The LF MRCC will be collocated with the DASC. If, because of space restrictions, the MRCC cannot be in the same space as the DASC, it will be in an area adjacent to and have direct communication with the DASC.

c. The LF MRCC must have the capability either to monitor the helicopter net or to listen to the intercommunication between the requestor for aeromedical evacuation, the DASC, and the helicopter. The LF MRCO will not communicate directly with either the requestor or the helicopter.

d. The LF MRCO will have direct communication over the Medical Regulating Net with all LF/ATF MRTs and the ATF MRCC.

e. An LF MRT will be located with each LF MTF and the BES or the Helicopter Evacuation Station (HES).

f. The BES must have the capability for reliable and instant communication with the Helicopter Support Team in the LFSP and with the applicable sections of the Beachmaster. The BEST MRT can act as a relay station between the LF MRCC and the ATF MRCC if required.

Coordinating Action

1. The ATF/LF requirements listed above and the medical regulation principles must be brought to the attention of the appropriate staff officers in the very early stages of planning. Space within the respective vehicle movement control agencies is at a premium; special arrangements may be required to ensure that an adequate interface exists between the medical regulating personnel and the control agencies. Further, the embarkation and landing plans are formulated early in the planning phase, and the requirements must be made known to the appropriate officers. All the information must be coordinated between the ATF and the LF and their subordinate commands.

2. The ATF Surgeon and the LF Surgeon will provide their respective MRCO with the information required for the proper planning and coordination of medical regulating. Normally, the MRCO will be assigned early in the planning phase; however if he is delayed in reporting, the Surgeon will have the responsibility for the planning of medical regulating. The planning of medical regulation will require detailed discussions. If the surgeon is planning medical regulating prior to the arrival of the MRCO, a detailed log will be maintained documenting the discussions, the action officer's name, functions, responsibilities, telephone numbers, and agreements reached. This log will be delivered to the MRCO on his arrival.

3. The detailed planning of medical regulating during an amphibious operation will require close coordination between staffs of the ATF and the LF. As a minimum, the Surgeons, the MRCO, the MRT, Division Surgeon, FSSG Surgeon, Wing Surgeon, and the Commanding Officer, Medical Battalion should be involved in the planning. The necessity for early planning and the involvement of cognizant staff officers from both the ATF and the LF is mandatory.

4. The ATF Surgeon will provide the ATF MRCO with information concerning the former's advance planning and coordination with members of the ATF staff. Since it is likely the ATF MRCO and his section(s) will be augmentees from a Naval Hospital and probably will not be acquainted with either details of the ATF and LF organization and operations or members of the staff, the ATF Surgeon must be prepared to conduct the planning jointly with the ATF MRCO when the latter arrives. It is possible the MRT augmentees will not arrive until shortly before embarkation, in which case the ATF Surgeon must not only conduct all the medical planning that is normally his responsibility, but must also personally engage in the detailed discussions and conferences wherein the details of implementing the medical regulating system are addressed. If the ATF MRCO is not provided by the augmentation process, the ATF Surgeon may have to perform this function or designate a ship's medical department officer as MRCO.

5. The CG FSSG will ensure that the Medical Battalion effects early coordination with the LF Surgeon and MRCO. The MRCO should be available from the Medical Battalion which has the mission of medical regulating. The Surgeon will further arrange introductory meetings between the LF MRCO, MAF, G-3, G-4, CEO, DASC, and the alternate DASC. At these meetings he will review the requirements for medical regulating so there is no misunderstanding of the demands placed on these sections. Thereafter, the LF MRCO performs the detailed planning with the respective sections to ensure the requirements are satisfied in the various plans.

6. It is important that the ATF MRCO be available in the planning phase, and the ATF Surgeon, ATF MRCO, LF Surgeon, the Commanding Officer, Medical Battalion, and the LF MRCO meet early and as frequently as feasible thereafter to conduct joint and coordinated planning for the smooth interface of the ATF

and LF medical regulating functions. In these meetings, it is important that all understand the capabilities and limitations of the medical regulating system, the medical support available to the ATF and LF, evacuation resources and capabilities, planning maneuvers of the ATF/LF, and such information needed to investigate and search for solutions to potential problem areas and weaknesses in the system. Problem areas will be referred to the cognizant officers for assistance in obtaining solutions.

TRIAGE

To speed evacuation of casualties, they will be grouped within one framework encompassing both the medical nature of the case and the logical order of evacuation. At each level of the evacuation chain, triage officers (or Medical Regulating Officers) must exercise their judgment in classifying casualties for evacuation to the next higher level of care. The following categories have been directed for use:

1. Category I - Immediate. Those cases with a good chance of survival if the indicated resuscitative/surgical measures are accomplished as soon as possible:

   a. Hemorrhage from a relatively accessible site.

   b. Some abdominal wounds (penetrating/perforating).

   c. Some chest wounds of similar nature.

   d. Easily correctable respiratory obstruction (such as facial burns, maxillofacial injury, cervical injury, etc.).

   e. Compound fractures of major bones.

   f. Incomplete amputations of major extremities.

   g. Crushing injury of major extremities.

   h. Second/third degree burns, over 20-50% of the body surface.

   i. Combination of above injuries, as individually assessed.

2. Category II - Delayed. Those cases where definitive treatment may safely be delayed without jeopardy to life, such as:

   a. Simple fractures of major bones.

   b. Soft tissue wounds without extensive bleeding.

   c. Relatively minor burns (non-facial).

   d. Non-critical injuries to the nervous system.

   e. Psychiatric disorders of incapacitating degree.

3. Category III - Minimal. Cases requiring minimal treatment who may either be returned to duty after treatment or be considered to require long term domiciliary/nursing care after treatment:

a. Minor soft tissue injuries.

b. Simple fractures of small bones.

c. Burns of minimal extent and degree (not involving face or hands).

d. Disabling simple fractures (hands, feet, etc.).

e. Burn cases whose injury interferes with ability to feed or otherwise care for himself.

f. Minor to moderate psychiatric cases.

4. Category IV - Expectant. Casualties whose therapy would be extensive:

a. Critical injuries to central nervous system or damage to hollow or solid visceral organs.

b. Severe abdominal wounds, involving extensive damage to hollow or solid visceral organs.

c. Severe multiple injuries.

d. Severe/extensive burns.

Casualties are considered for evacuation in order by category. Category IV will not be evacuated until the other groups have been treated and personnel, equipment, and bed space is available at supporting facilities.

Remains will not be evacuated through the medical system. The Care of the Dead program will be utilized. The FSSG is responsible for collection, preparation and evacuation of the dead within the LF and is the point for coordination with the U.S. Army's Grave Registration program.

GLOSSARY OF DEFINITIONS

Advance Force. A component of the amphibious task force which precedes the main body to the objective area. Its function is to prepare the objective for assault by conducting such operations as reconnaissance minesweeping, preliminary bombardment, underwater demolition operations, and air operations.

Advance to Contact. An offensive operation designed to gain initial ground contact with the enemy or to regain lost contact.

Aeromedical Evacuation. The movement of patients under medical supervision to and between medical treatment facilities by air transportation.

Aeromedical Evacuation Control Center (AECC). The control facility established by the commander of an airlift division, Air Force, or air command. It operates in conjunction with the command's movement control center and coordinates overall medical requirements with airlift capability. It also assigns medical missions to the appropriate aeromedical evacuation elements in the system and monitors patient movement activities.

Aeromedical Evacuation Liaison Teams (AELT). A U.S. Air Force unit that coordinates aircraft availability with the AECC and the movement of casualties with the Medical Regulating Control Center (MRCC) to smooth evacuation by the Tactical Aeromedical Evacuation System (TAES).

Aeromedical Evacuation System. A system which provides: (a) control of patient movement by air transport; (b) specialized medical attendants and equipment for in-flight medical care; (c) facilities, on or in the vicinity of air strips and air bases for the limited medical care of in-transit patient entering, en route, via, or leaving the system; (d) communication with originating, en route and destination medical facilities concerning patient requirements.

Amphibious Operation. An attack launched from the sea by naval and landing forces embarked in ships or craft involving a landing on a hostile shore.

Amphibious Operating Area/Area of Responsibility (AOA/AOR). A designated area within a theater, under a task force commander subordinate to the theater commander, who has responsibility for all air, land and sea operations within the boundaries of his area. AOR is a NATO term for the same area.

Amphibious Planning. The process of planning for an amphibious operation, distinguished by the necessity for concurrent, parallel and detailed planning by all participating forces, wherein the planning pattern is cyclical in nature, comprising a series of analyses and judgments of operational situations, each stemming from those that have preceded.

Amphibious Withdrawal. A lesser included type of amphibious operation involving the withdrawal of forces by sea in naval ships or craft from a hostile shore.

Armed Services Medical Regulating Office (ASMRO). Based in the Continental United States (CONUS), has the responsibility of arranging the movement of casualties from within the communication zone to tertiary medical treatment facilities within CONUS.

Assault. In an amphibious operation, the period of time from the crossing of the line of departure (LOD) by the first scheduled wave to the seizure of the initial objectives.

Attack. An offensive action characterized by movement supported by fire.

Aviation Combat Element. The aviation combat element of a MAGTF is task organized to provide the required functions of Marine aviation. These functions--air reconnaissance, anti-air warfare, assault support, offensive air support, electronic warfare, and control of aircraft and missiles--are provided in varying degrees based on the tactical situation and the size of the MAGTF. Normally, there is only one aviation combat element in a MAGTF. It includes those aviation command (including air control agencies), combat, combat support, and combat service support units required by the situation. It varies in size from an aircraft squadron to an aircraft wing.

Battalion Aid Station. The battalion aid station group is manned by hospital corpsmen of the battalion medical section under the direction of the assistant battalion surgeon. The aid station group is capable of establishing and operating two aid stations when necessary (the second headed by the battalion surgeon). The function of the aid station includes: recording all casualties received; examining and sorting casualties for disposition; providing temporary shelter and emergency treatment such as redressing wounds, applying or adjusting splints, and giving morphine antibiotics and plasma or plasma substitutes; transferring evacuees from the aid station to litters, ambulances, or helicopters for further evacuation to the rear; initially treating nonbattle casualties and holding those whose conditions will permit early return to duty; treating the majority of acute combat psychiatric cases; providing routine sick call for battalion personnel including immunization, as required; maintaining health records of battalion personnel; and providing replacement for the company medical teams.

Beach Evacuation Station (BES). A medical component of the Landing Force Support Party responsible for the collection, triage, emergency treatment, stabilization and evacuation of combat casualties received on the beach. The BES is normally composed of a Shock and Surgical team, an Evacuation Platoon, and a Medical Regulating Team from the Medical Battalion Force Service Support Group (FSSG).

Beachhead. A designated area on a hostile shore which, when secured, ensures the continuous landing of troops and materiel and provides maneuver space requisite for subsequent projected operations ashore. The beachhead is the physical objective of an amphibious operation.

Brigade Service Support Group (BSSG). The BSSG is task organized and tailored to provide combat service support beyond the organic capability of the supported air and ground elements and is structured from the personnel and equipment assets of the FSSG.

Casualty. Any person who is lost to his organization by reason of having been declared dead, wounded, injured, diseased, interned, captured, missing; or a person whose whereabouts or status has not been determined.

Casualty Evacuation Station. A station which operates as a central collection and staging facility for patients requiring seaward evacuation.

Casualty Overload. A situation where the number of casualties exceeds the capability of the medical facility to provide adequate care. This situation may occur at one or more facilities simultaneously. Normally when 80% of a facility's beds are occupied or a 6-hour surgical backload exists, the Medical Treatment Facility (MTF) is in overload.

Casualty Receiving and Treatment Ship (CRTS). A ship of the Amphibious Task Force with required operational capability and resources to provide medical treatment and evacuation of casualties.

Casualty Staging Facility. The medical facility tasked with the mission of holding patients temporarily, providing non-emergency type of treatment, and preparing of casualties for rapid loading aboard scheduled evacuation aircraft, either fixed wing, or helicopter, for transport out of the ATF or Landing Force area of responsibility. This facility is prepared to continue treatment of evacuees but not to initiate new treatment regimens. In joint operations, this facility is provided by the U.S. Air Force as part of the Joint Medical Regulating Office (JMRO) system and is usually located at the theater air base. See Mobile Aeromedical Staging Facility (MASF).

Cold Weather Operations. Amphibious operations conducted under cold weather conditions and in sea-ice areas following the same basic principles as amphibious operations under other conditions. Cold weather amphibious operations, however, impose certain limitations on the amphibious task force because of reduced visibility; effects of sea-ice on mobility of ships, landing craft, and amphibious vehicles; possible loss of or decreased reliability of communications; effects of low temperatures on efficiency of personnel and materiel; and poor cross-country mobility. These limitations required careful and detailed consideration during planning and preparation for cold weather amphibious operations.

Combat Service Support Element. The combat service support element is a task organization tailored to provide combat service support to the MAGTF that is beyond the organic capability of the subordinate elements. Depending on the assigned mission, it is task organized to provide any or all of the following functions: supply, maintenance, engineer, medical/dental, automated data processing, material handling equipment, personal service, food services, transportation, military police, disbursing, and financial management. It is capable, to a limited extent, of providing smaller task organizations such as maintenance/supply contact teams for support of MAGTF operations as required.

Command Element. The command element is the MAGTF headquarters. It is composed of the commander, the general or executive and special staff sections, the headquarters section, and the requisite communication and service support facilities.

Commander, Amphibious Task Force. A Navy officer responsible for the operation who exercises the degree of authority over the entire force that is necessary to ensure success of the operation.

Commander, Landing Force. The officer designated in the initiating directive to command the landing force.

Company Corpsman. A U.S. Navy Corpsman trained at a Field Medical Service School (FMSS) to go into combat with Marines. The Company Corpsman is the first care that sick, injured, or wounded Marines receive from medically trained personnel. If emergency or lifesaving measures are required prior to Company Corpsman care, they must be performed by Marines trained in first aid, self aid or buddy aid.

Defensive Operations. Operations conducted with the immediate purpose of causing an enemy attack to fail. Defensive operations also may achieve one or more of the following: gain time; concentrate force elsewhere; wear down enemy forces as a prelude to offensive operations; and retain tactical, strategic, or political objectives.

Demonstration. An amphibious operation conducted for the purpose of deceiving the enemy by a show of force with the expectation of deluding the enemy into a course of action unfavorable to him. The demonstration is a feint at landing involving an approach to a beach or landing zone. It is intended to confuse the defender as to the time, place or strength of the main attack, and normally includes preparatory and supporting fires.

Died of Wounds Received in Action. Battle casualties who die of wounds or other injuries received in action after they have reached any medical/dental treatment facility.

Direct Air Support Center (DASC). The DASC is a Landing Force element which controls and coordinates all helicopter and aircraft movement in the AOA once command has been phased ashore.

Disease and Non-Battle Injury (DNBI). A casualty status that resulted from a cause other than combat.

Double Envelopment. A form of enveloping maneuver executed by forces which move around both flanks of an enemy position to attack the flanks or objectives in the rear of the enemy. The enemy normally is fixed in position by a supporting frontal attack or by indirect and/or aerial fires.

Economy of Force (principle of war). Allocate minimum essential combat power to secondary efforts.

Embarkation. The embarkation phase is the period during which the forces, with their equipment and supplies, are embarked in the assigned shipping.

Evacuation. The movement of casualties from a hostile or adverse environment to one in which effective treatment can be administered with a minimum of interference in operations.

Evacuation Policy. A command decision which indicates the length of hospitalization, in days, or the maximum period that patients may be held within the theater/AOA for treatment. Patients who return to duty status within the per-

iod prescribed are evacuated by available means, provided the travel involved will not aggravate disabilities.

Exploitation. An offensive operation that usually follows a successful attack to take advantage of weakened or collapsed enemy defenses. Its purpose is to prevent reconstitution of enemy defenses, to prevent enemy withdrawal, and to secure deep objectives.

Ground Combat Element. The ground combat element is a task organization tailored for the conduct of ground maneuvers. It is constructed around an infantry or armored unit and varies in size from a battalion landing team to a reinforced Marine division or divisions.

Helicopter Coordination Section (HCS) Provides flight supervision and coordination for all helicopters in the AOA and monitors flight control by HDC when air control is vested afloat with the Commander Amphibious Task Force (CATF). An HCS is established when more than one Helicopter Direction Center (HDC) is functional in the AOA.

Helicopter Direction Center (HDC). The HDC is an Amphibious Task Force element which controls and coordinates all helicopter and aircraft movement in the AOA prior to control being passed ashore. It is equivalent to the CLF DASC.

Helicopter Landing Zone (HLZ). A specified ground area for landing assault helicopters to embark or disembark troops and/or cargo.

Helicopter Evacuation Station (HES). A medical component of the Helicopter Support Team which is responsible for the collection, triage, emergency treatment, and evacuation of combat casualties from a landing zone.

H-Hour. The specific hour on D-Day at which a particular operation commences.

Hospital Company. A combat service support element configured to provide a 6-surgical suite, 200-bed emergency surgical hospital. Surgical disciplines include general surgery, orthopedic surgery, opthalmic surgery, neurosurgery,

thoracic surgery, and oral surgery. Intensity is directed toward life/limb/organ surgery and patient stabilization for evacuation to a definitive care facility or return to duty. Other disciplines include anesthesia, internal medicine and psychiatry. A full range of ancillary services exist within the hospital; i.e., laboratory, pharmacy, x-ray, dermatology, casting, nursing, and emergency room procedures. Functions include: receiving, sorting and emergency care (triage); diagnostic workups; shock and debridement/presurgical holding; surgery; minor surgery; postoperative intensive care; ward nursing/evacuation preparation; and sterile supply.

Initiating Directive. The directive initiating an amphibious operation, issued by a commander of a command established by the Joint Chiefs of Staff or by other commanders so authorized by the Joint Chiefs of Staff or by other higher authority.

Joint Medical Regulating Office (JMRO). An organization responsible for medical regulating out of the AOA and for providing liaison with ASMRO. JMRO is established by the theater CINC and may have several sub-area JMROs when more than one AOA is established in a theater.

Killed in Action (KIA). Battle casualties who are killed outright or die of wounds/injuries before reaching a medical/dental facility.

Landing Force. The landing force comprises the troop units, aviation and ground, assigned thereto to conduct the amphibious assault.

Landings in Low Visibility. A landing in reduced visibility is defined as one in which the ship-to-shore movement is executed and at least the initial objective is captured under cover of darkness or under limited light conditions imposed by fog, rain, snow, or smoke.

Maneuver (principles of war). Place the enemy in a position of disadvantage through the flexible application of combat power.

Mass (principle of war). Concentrate combat power at the decisive place and time.

Mass Casualty. A situation in which the number of casualties overwhelms the treatment capabilities of all treatment facilities within the AOA and the immediate rearward evacuation destinations. The priority of treatment is based almost solely on the probability of the casualty's survival rather than the saving of a limb or function.

Medical Boat. A designated Amphibious Task Force landing craft tasked to transport casualties from the beach to the CRTS. Medical Boats are equipped and usually operated from each battalion landing beach. The medical boat flies an "M" flag over the beach designating flag. Personnel include the crew, medical personnel, and communications personnel. The equipment includes first aid supplies, litters (not less than 20 for exchange), voice and visual communications equipment, and spare tarpaulins.

Medical Company. A Medical Company is a combat service support element. The function of the medical company is to establish and operate a field emergency surgical hospital. It consists of two operating rooms and has a 60-bed ward holding capability. Surgical disciplines include general surgery and orthopedic surgery. A full range of services are included in the hospital: triage; laboratory; x-ray; pharmacy; shock and debridement; presurgical holding; post-surgical intensive care; ward nursing and evacuation preparation care; minor surgery; major surgery; and sterile supply. The intensity of surgery is directed toward emergency/lifesaving/limb-organ saving procedures, and patient stabilization for evacuation to a definitive care facility. Equipment and supplies are included for performing maxillo-facial surgical procedures. The company will be augmented with an oral surgeon and technician for these procedures.

Medical Regulating. The system in which combat casualties are evacuated from the site of injury through successive echelons of medical care to a definitive or tertiary medical treatment facility in the communication zone or CONUS.

Medical Regulating Control Center (MRCC). The coordinating center for the regulation of casualties within the AOA. The ATF MRCC is normally established with the HDC, LFOC, or the Primary Control Ship afloat and is directed and

supervised by the Medical Regulating Control Officer. When control of Medical Regulating passes ashore the LF MRCC collocated with the DASC performs the MRCC functions.

Medical Regulating Control Officer (MRCO). An officer or senior enlisted person, usually of the medical department of the Amphibious Task Force or the Medical Regulating team leader, who is responsible for coordinating the regulation of casualties throughout the task force. The ATF MRCO directs the operations of the ATF Medical Regulating Control Center, coordinates the operation of the Medical Regulating Teams, and is the net control for the Medical Regulating Net. The LF MRCO is responsible for operation of the LF MRCC and coordinating of the MRT/MRS of the landing force and net control when OPCON passes ashore. The LF MRCO works under the direction of the MSOC.

Medical Regulating Section (MRS). An organized unit of the LF tasked with operation of the ATF MRCC. MRS personnel man the MRCC. In the LF, the MRS is organic to the Medical Battalion.

Medical Regulating Team (MRT). A team of medical regulators and radio operators assigned to medical treatment facilities, under the direct supervision of a Medical Regulating Officer. The team receives and maintains correct information regarding the medical capabilities of the medical treatment facilities within the AOA and coordinates the regulation of casualties under their cognizance. The ATF MRT is staffed by augmentation of Mobile Medical Augmentation Readiness Team (M-MART) or ship personnel. The LF MRT is staffed from the Medical Battalion FSSG. An MRT consists of one or more people, depending on the size of the operation.

Medical Support Operations Center (MSOC). A medical coordinating center that coordinates all medical/dental operations in the Landing Force. The LF MRCC is an element of the MSOC. The MSOC is staffed by personnel of the FSSG and other personnel as directed by the CLF. The MSOC is collocated with the logistics element headquarters and under the operational control (OPCON) of the CLF. Staff cognizance is exercised through the CLF Surgeon.

Medical Treatment Facility (MTF). A medical installation of any size, ranging from a battalion/squadron aid station in the Landing Force or sickbays in the Amphibious Task Force to fixed hospitals or hospital ships capable of providing definitive treatment. In this report the term "medical treatment facility" will be used as a non-specific medical installation.

Movement Control Agency. The HDC, PCS or DASC controlling the vehicles used for evacuation of casualties.

Movement to the Objective Area. Movement of the amphibious task force to the objective area includes: departure of ships from loading points in an embarkation area; the passage at sea; and the approach to, and arrival in, assigned positions in the objective area.

Objective (principle of war). Direct every military operation toward a clearly defined, decisive, and attainable objective.

Objective Area. A defined geographical area within which is located an objective to be captured or reached by the military forces. This area is defined by competent authority for purposes of command and control. In amphibious operations the objective area is delineated in the initiating directives in terms of sea, land, and air space.

Occupied Beds. Those operating beds occupied by casualties.

Offensive (principle of war). Seize, retain, and exploit the initiative.

Operating Beds. Beds set up, equipped and staffed to care for casualties.

Operating Room (Major). A fully equipped and staffed operating room capable of supporting specialized or extensive surgical care.

Operating Room (Minor). A treatment room/area that does not have the equipment and staff to support surgical cases but is usable for treatment of shock, minor injuries, pre-surgical procedures, etc.

Operation Order. A directive issued by a commander to subordinate commanders for effecting the coordinated execution of an operation; includes tactical movement orders.

Operation Plan. A plan for a military operation. It covers a single operation or a series of connected operations to be carried out simultaneously or in succession. It implements operations derived from the campaign plan. When the time and/or conditions under which the plan is to be placed in effect occur, the plan becomes an operation order.

Overflow Beds. Beds (troop berthing) that may be used for casualties. These beds are normally staffed by augmentation personnel and used for casualty holding and/or evacuation by sea.

Preassault Operations. Operations, preparatory to an amphibious operation, are conducted for the following purposes: (1) to isolate the objective area; (2) to gain information of the enemy; and (3) to prepare the objective area.

Primary Casualty Receiving and Treatment Ship (PCRTS). A CRTS with better capability than other ships designated as CRTS and which has been stated in the ATF operation order as the one to which casualties will preferably be directed. Examples of this are the LHD, LHA and LPH.

Primary Control Ship (PCS). A designated ship of the Amphibious Task Force which controls and coordinates the movement of all landing craft to and from a designated beach.

Pursuit. An offensive operation against a retreating enemy force. It follows a successful attack or exploitation and is ordered when the enemy cannot conduct an organized defense and attempts to disengage. Its object is to maintain relentless pressure on the enemy and completely destroy him.

Raid. An amphibious raid is a landing from the sea on a hostile shore involving swift incursion into or temporary occupancy of an objective followed by a planned withdrawal.

Rehearsal. The rehearsal is that phase of an amphibious task force or elements thereof, under conditions approximating those of the contemplated amphibious operation.

Secondary Casualty Receiving and Treatment Ship (SCRTS). A CRTS designated in the ATF operation orders as having lesser medical treatment capability and resources than the PCRTS. Examples of these are the LSD-41, LPD and LKA.

Security (principle of war). Never permit the enemy to acquire an unexpected advantage.

Simplicity (principle of war). Prepare clear, uncomplicated plans and clear, concise orders to ensure thorough understanding.

Surprise (principle of war). Strike the enemy at a time and/or place and in a manner in which he is unprepared.

Symbol. A sign composed of a diagram, number, abbreviation, color, or combination thereof which is used to identify and distinguish a particular military unit, activity, or installation.

Tactical Air Control Center (TACC). The TACC, established aboard the ATF flagship, is the primary air control agency within the amphibious objective area (AOA) or designated area of responsibility from which all air operations supporting the amphibious force are controlled.

Triage. The sorting of casualties to determine and designate the priority and type of care required to meet the casualties medical needs consistent with the extent and availability of the indicated care.

Unity of Command (principle of war). For every objective ensure unity of effort under one responsible commander.

Withdrawal. An amphibious withdrawal is a withdrawal of forces by sea in naval ships or craft from a hostile shore. The purpose of the amphibious withdrawal is to disengage forces for employment elsewhere.

PART II

MEDICAL COMMUNICATIONS

ACRONYMS AND ABBREVATIONS RELATING TO COMPUTER/COMMUNICATIONS

AM	- Amplitude Modulation
BCH	- Bose-Chaudhuri-Hocquenghem
dB	- Decibel
FM	- Frequency Modulation
FSK	- Frequency Shift Keying
HF	- High Frequency
I/O	- Input/Ouput
JKF Box	- Interface Box
KAM	- Crypto Manual
Kb/S	- Kilobits Per Second
LAN	- Local Area Network
LOS	- Line of Sight
MHz	- MegaHertz
MIL STD	- Military Standard
MODEM	- Modulator and Demodulator
MS-DOS	- Disk Operating System
PLL	- Phase Lock Loop
PM	- Phase Modulation
PSK	- Phase Shift Keying
Rx	- Receiver
SATCOM	- Satellite Communications
SNR	- Signal-to-Noise Ratio
TAMMIS	- Theater Army Medical Management Information System
Tx	- Transmitter
UHF	- Ultra High Frequency
VHF	- Very High Frequency

MEDICAL REGULATING COMMUNICATIONS

1. All communication procedures will be in accordance with ACP 125 (D), "Allied Communication Publication, Radiotelephone Procedure". The formal radio communication net for the medical regulating system is the Medical Regulating Net. This is normally a non-secure voice HF Net. While the advantages of a secure voice net are obvious, the Geneva Convention of 1949 has precluded their use for medical purposes.

2. The primary purpose of the Medical Regulating Net is to provide a means of rapid communication between the Medical Regulating Center and the Medical Regulating Teams, ensuring that the former continually has current information on the capabilities of the established medical facilities. Although the net may be used for other secondary purposes, these must be kept to an absolute minimum. Currently, the only other information to be passed over this net is the Whole Blood Report and requests for blood within the ATF/LF.

3. Requests for transportation, personnel, supplies, or other logistic/administrative matters are not passed over the Medical Regulating Net. The TAR Net is utilized to request aircraft. The Combat Service Support; Net (CSS Net) or the Combat Service Support Net is used to request other logistic/administrative support. Annex K of the OPORD will give guidance on the use of the various nets and who controls each net. Annex K is to be reviewed by each MRT early in the pre-exercise planning.

4. While the Medical Regulating Net is the principle means of communication, alternative methods must always be planned. Regulators must always be aware of other radio nets located in the area plus the availability of message, teletype, signal, telephone, or messenger systems.

Responsibilities of the Communications Officers.

The ATF Communications Officer and the LF Communications-Electronics Officer will ensure that the communications requirements of the medical regulating system are addressed in all OPORDS/OPLANS. They will further ensure that the respective communications officers of their subordinate commands implement the medical regulating system communications plan.

1. The ATF Communications Officer will ensure:

a. the ATF MRCO and MRTs have the proper communication equipment, training, code, and encryption/decryption, publications, and supporting services.

b. the MRT aboard the Amphibious Assault Ship (general purpose) (LHA)/Amphibious Assault Ship (helicopter) (LPH), if not located in the same space with HDC, has instant and reliable two-way communication with HDC. If a TACC is established, the MRCC will be collocated with them and an MRT located at the HDC.

c. the MRT aboard the PCS, if not located in the same space with the CIC, has instant and reliable two-way communications with them.

d. compatibility with U.S. Air Force and U.S. Army systems during joint operations.

2. The LF Communications-Electronics Officer will ensure:

a. the LF MRCO has communications with the LF MRTs once established ashore.

b. the LF MRCO, collocated with or in the vicinity of DASC, has the proper communication equipment, publications for authentication, and encryption and training.

c. the LF MRCO has telephone connectivity into the Marine Air-Ground Task Force (MAGTF) telephone system.

d. the BES has positive communication links with the Beachmaster and Shore Party Commander.

e. the LF medical regulating net communications equipment is compatible with the ATF.

f. compatibility with U.S. Air Force and U.S. Army systems during joint operations.

Communications Procedures.

Encryption of information on the number and types of casualties, unit identification, location, and amounts of blood required is necessary to ensure enemy forces cannot exploit our net for their own intelligence purposes. Other types of information, called Essential Elements of Friendly Information (EEFI) may have to be encrypted to protect security. The individual drafting

a message or using the radio must ensure operational security is not violated to speed up communications.

Medical Regulating Net.

1. The Medical Battalion FSSG is tasked in its mission statement with the responsibility for conducting medical regulating for the LF. Its Table of Organization and Table of Equipment provide the means with which to accomplish this mission. The CATF receives medical regulators from augmentation personnel provided on request by the CINC. The CATF provides equipment to his regulators.

2. The following stations will be on the Medical Regulating Net:

a. In the ATF: The following agencies reflected in the Typical Task Force Medical Regulating Organization in Naval Warfare Publication (NWP) 22 will be included in the Medical Regulating Net:

(1) Task Force Medical Regulating Control Center staffed by a Medical Regulating Section (MRS).

(2) HDC staffed by an MRT.

(3) Naval Control Organization Commander/PCS, staffed by an MRT.

(4) Other CRTSs as directed by the ATF OPORD/OPLAN staffed by an MRT.

b. In the LF:

(1) The LF MRCC located with the DASC staffed by an MRS.

(2) The LF Alternate Medical Regulating Control Officer (AMRCO) located with the alternate DASC.

(3) An MRT located with each LF MTF.

(4) An MRT located with any Beach/Helicopter site having MTF capabilities.

3. Coordinating Instructions

a. Net Control

(1) During the initial amphibious assault and until CLF assumes control ashore, the ATF MRCC will assume net control of the Medical Regulating Net.

(2) In the event the ATF MRCC loses communications, net control will be assumed by an MRT predesignated in the ATF OPORD/OPLAN.

(3) When field hospital facilities of the landing force are established ashore and when an adequately staffed and functioning LF MRCC is established, responsibility for accomplishing this medical regulating of casualties and net control will be formally passed ashore at a specific time. Thereafter, the LF MRCC is advised of the medical capability of ships in the objective area in order that casualties may be evacuated seaward as necessary.

(4) The ATF MRCC should remain prepared to resume responsibility for the medical regulating functions, including control of the net, should the LF find it necessary to pass this responsibility back to the afloat forces.

(5) Procedures for control of the net will be conducted in accordance with current radio and communications security requirements as directed by policy and the OPORD/OPLAN.

b. All stations designated to be on the Medical Regulating Net will be prepared, and up on the net in accordance with the OPORD/OPLAN and/or as directed by the LF Surgeon.

c. Medical Regulating Net stations encountering communications equipment problems and unable to come up on the net will report such deficiencies to the supporting command's communication officer for corrective action. In addition, a report will be submitted to CATF/CLF that includes the deficiency, estimated time of repair, and recommendations for alternative communications.

MEDICAL RECORD COMMUNICATIONS

Field Medical Record Flow.

All of the major elements usually inherent in the treatment and evacuation chain, and how the patient and his field medical records flow through it, are portrayed in Figure 6.

Permanent Medical Record Flow.

The parallel path of the permanent medical record is portrayed in Figure 7. (Details of the present medical treatment and evacuation chain are given in another section of this report.)

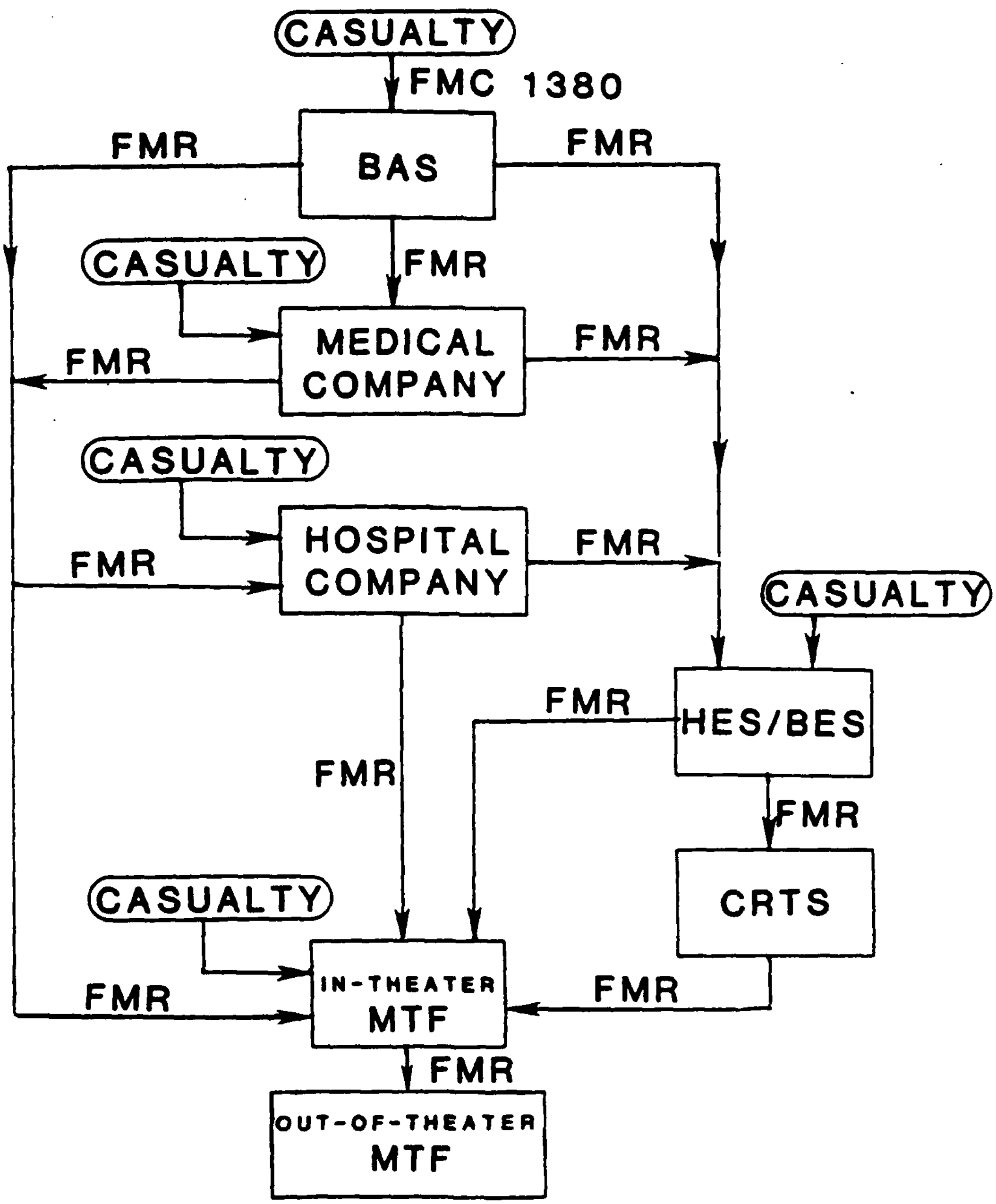

FIGURE 6. PATIENT/FIELD MEDICAL RECORD (FMR) FLCW

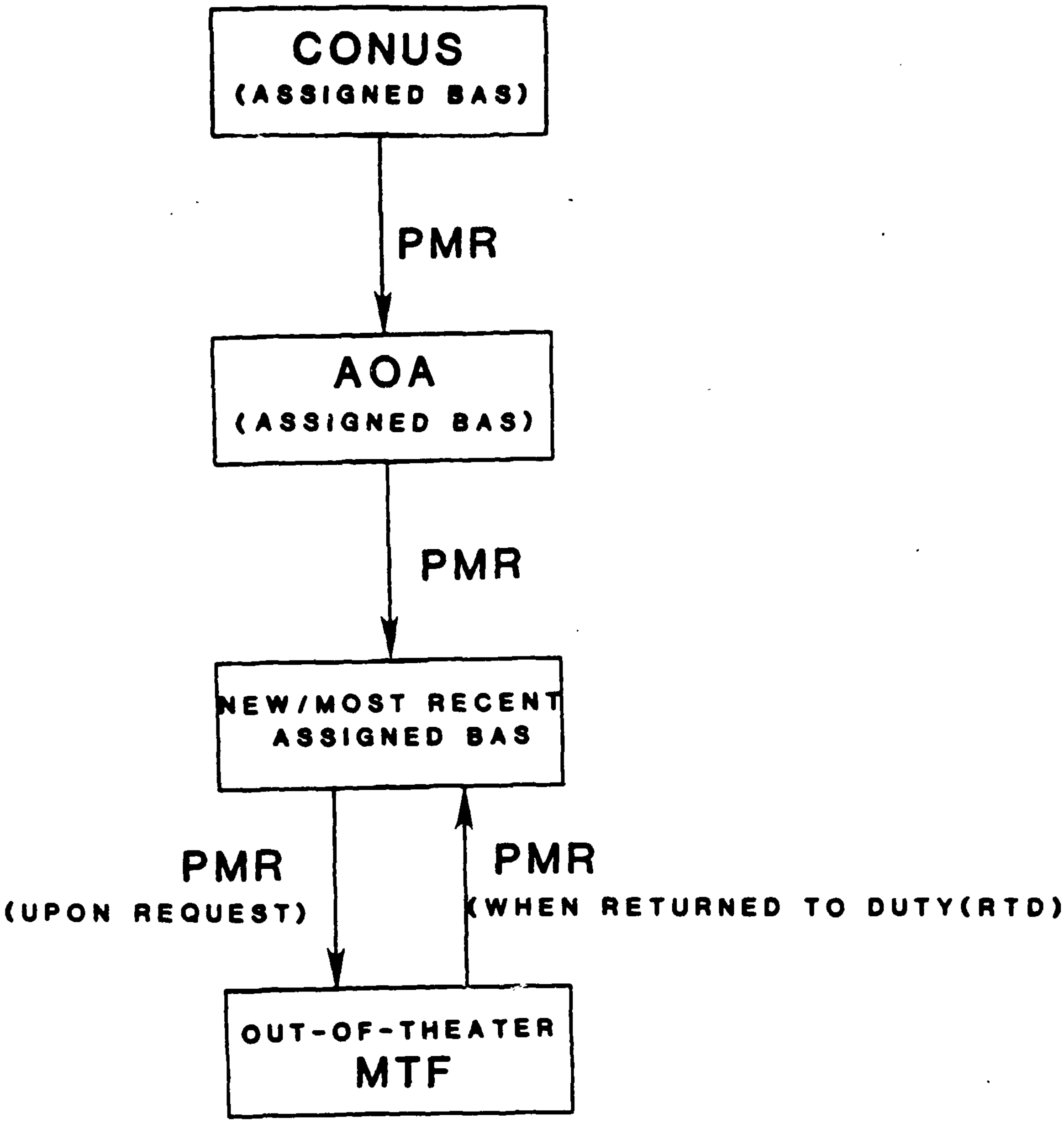

FIGURE 7. PERMANENT MEDICAL RECORD (PMR) FLOW

MEDICAL DATA COMMUNICATIONS

In this section, the major medical data communications areas of protocol, error control, secure communications, JKF Box, communications with TAMMIS and communications with the U.S. Air Force will be discussed.

Protocol.

In this section, we will consider the "hand shaking" required to establish the communications, transfer the data, and terminate the communications. For example, a general sequence of crypto transmission is represented in Figure 8.

For two entities (e.g., user application programs, file transfer packages, data base management systems, electronic mail facilities, and terminals) to successfully communicate, they must "speak the same language". What is communicated, how it is communicated, and when it is communicated must conform to some mutually acceptable set of conventions between the entities involved. This set of conventions is referred to as a "protocol", which may be defined as a set of rules governing the exchange of data between two entities. The key elements of a protocol are: (a) Syntax which includes such things as data format, coding, and signal levels; (b) Semantics which includes control information for coordination and error handling; and (c) Timing which includes speed matching and sequencing.

1. Establishing Communications. Establishing communications requires that the data to be transferred are ready to be sent by the transmitter and that this readiness is communicated to the receiver. The receiver should be prepared to receive this data and should communicate this to the transmitter. For example, in the case of packet switching, a header on each packet of the transmission would contain the source, destination and sequence number of the transmission. This allows the receiver to reassemble, in correct sequence, the various packets of the transmission, even those that took alternate routes. Measures must also be taken to avoid and recover from packet collisions.

2. Data Transfer. Once the communications have been established, the data are transferred. This requires that the receiver is sensitive enough to receive the transmission, has the capability to decode the encoded data, has the capability to decipher the enciphered data, and has the necessary synchronization ability.

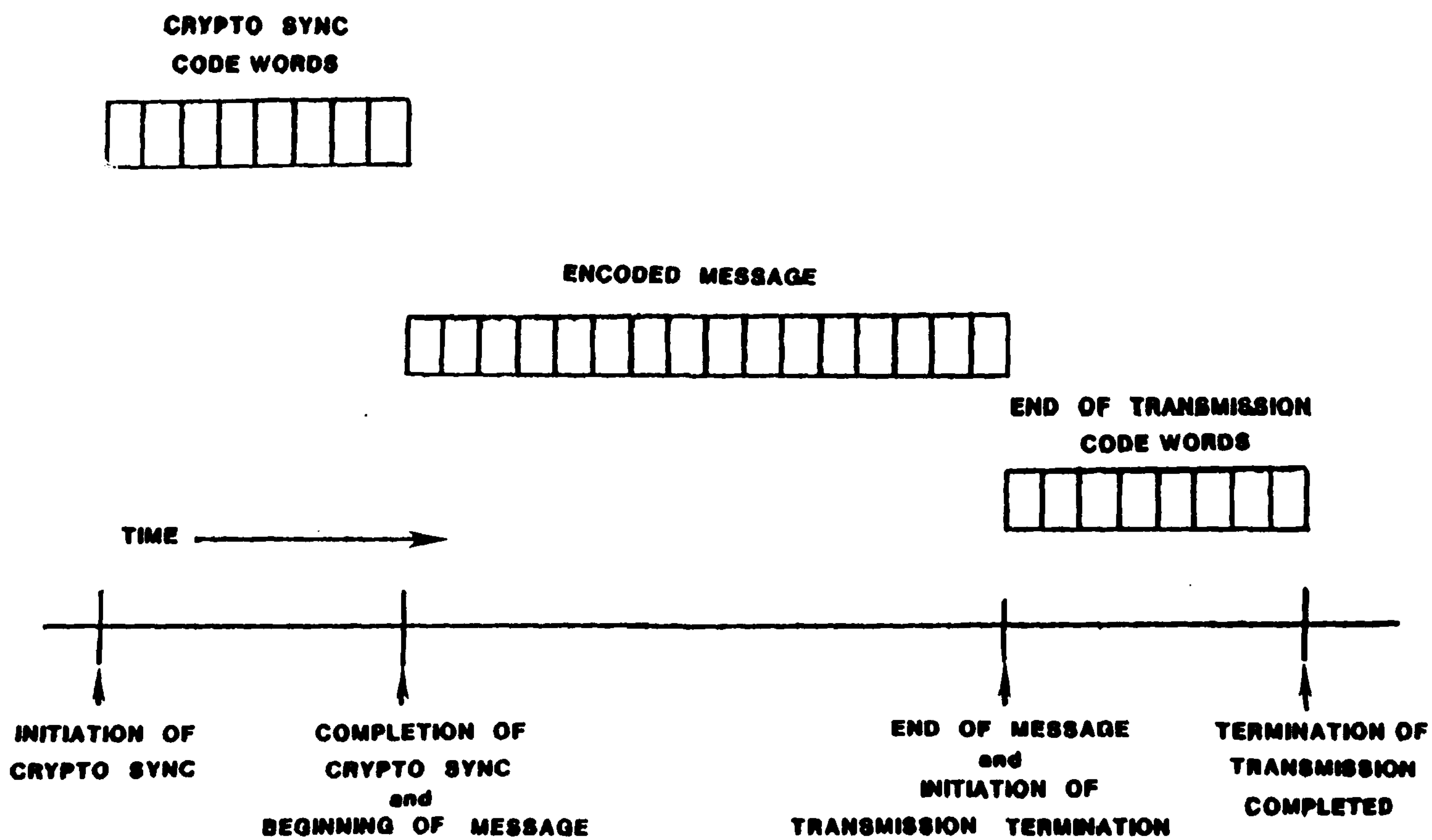

FIGURE 8. GENERAL SEQUENCE OF CRYPTO TRANSMISSION

3. Terminating Communications. In order to simplify efficient use of the communications link, a code signifying termination of the transmission is used which minimizes the time the receiver waits to detect end of transmission.

4. Transmission Mode. The two general data transmission modes are asynchronous and synchronous. The asynchronous mode requires start and stop control bits for each character sent. The synchronous mode only requires control bits for a much larger set of characters called a "block" or "frame". The synchronous mode is based on a master-slave clock system, where a phase lock loop (PLL) is used at the receiver to extract the clock from the data. This coherent operation (i.e. knowing the phase) gives up to an equivalent of 3 dB signal-to-noise ratio (SNR) improvement over the asynchronous mode. Other advantages of the synchronous mode are that much fewer control bits are required, much of the crypto traffic is synchronous, and a higher data rate can be transmitted than with asynchronous transmission because there is no need to stop and start between characters. Therefore, it is recommended that the primary transmission mode be synchronous.

5. Computer/Communications Architecture. When the system requirements exceed the capability of a single protocol, then a set of protocols that exhibits a hierarchical or layered structure is used. Lower level, more primitive functions are implemented in lower level entities that provide services to higher-level entities. This structure is referred to as a computer-communications architecture.

The communications functions are partitioned into a vertical set of layers. Each layer performs a related subset of the functions required to communicate with another system. Examples of systems are computers, terminals, and remote sensors. It relies on the next lower layer to perform more primitive functions and to conceal the details of those functions. It provides services to the next higher layer. Ideally, the layers should be defined so that changes in one layer do not require change in the other layers. Thus, we have decomposed one problem into a number of more manageable subproblems.

The partitioning should group functions logically, and should have enough layers to make each layer manageably small, but should not have so many layers that the processing overhead imposed by the collection of layers is burdensome. An example is the Open System Interconnection (OSI) reference model. The OSI model provides the basis for connecting "open" systems (e.g., computers, terminals, and remote sensors) for distributed applications processing.

The term "open" denotes the ability of any two systems conforming to the reference model and the associated standards to connect. The OSI reference model has seven layers: physical, data link, network, transport, session, presentation, and application.

Two systems, no matter how different, can communicate effectively if they have the following in common: a) they implement the same set of communications functions; b) these functions are organized into the same set of layers. Peer layers must provide the same functions, but note that it is not necessary that they provide them in the same way; and c) peer layers must share a common protocol.

To assure the above, standards are needed. Standards must define the functions and services to be provided by a layer (but not how it is to be done--that may differ from system to system). Standards must also define the protocols between peer layers (each protocol must be identical for the two peer layers). The OSI model, by defining a seven-layer architecture, provides a framework for defining these standards.

The following paragraphs define, in general terms, the functions that must be performed in a system for it to communicate. Of course, it takes two to communicate, so the same set of layered functions must exist in two systems. Communication is achieved by having corresponding "peer" entities in the same layer in two different systems communicating via a protocol. The general structure of the OSI reference model is depicted in Figure 9.

a. Physical Layer. The physical layer is concerned with transmission of unstructured bit streams over a physical medium. It deals with the mechanical, electrical, functional and procedural characteristics of accessing the medium. The digital data processing devices, which include terminals and computers, are generically referred to as data terminal equipment (DTE). DTE makes use of the transmission system through the mediation of data circuit-terminating equipment (DCE). An example of the latter is a modem used to connect digital devices to voice-grade lines.

b. Data Link Layer. The data link layer provides for the reliable transfer of information across the physical link. It sends blocks of data (frames) with the necessary synchronization, error control, and flow control. A physical interface or protocol provides only a raw bit stream service, which is subject to error. A data link protocol is used to manage the communication

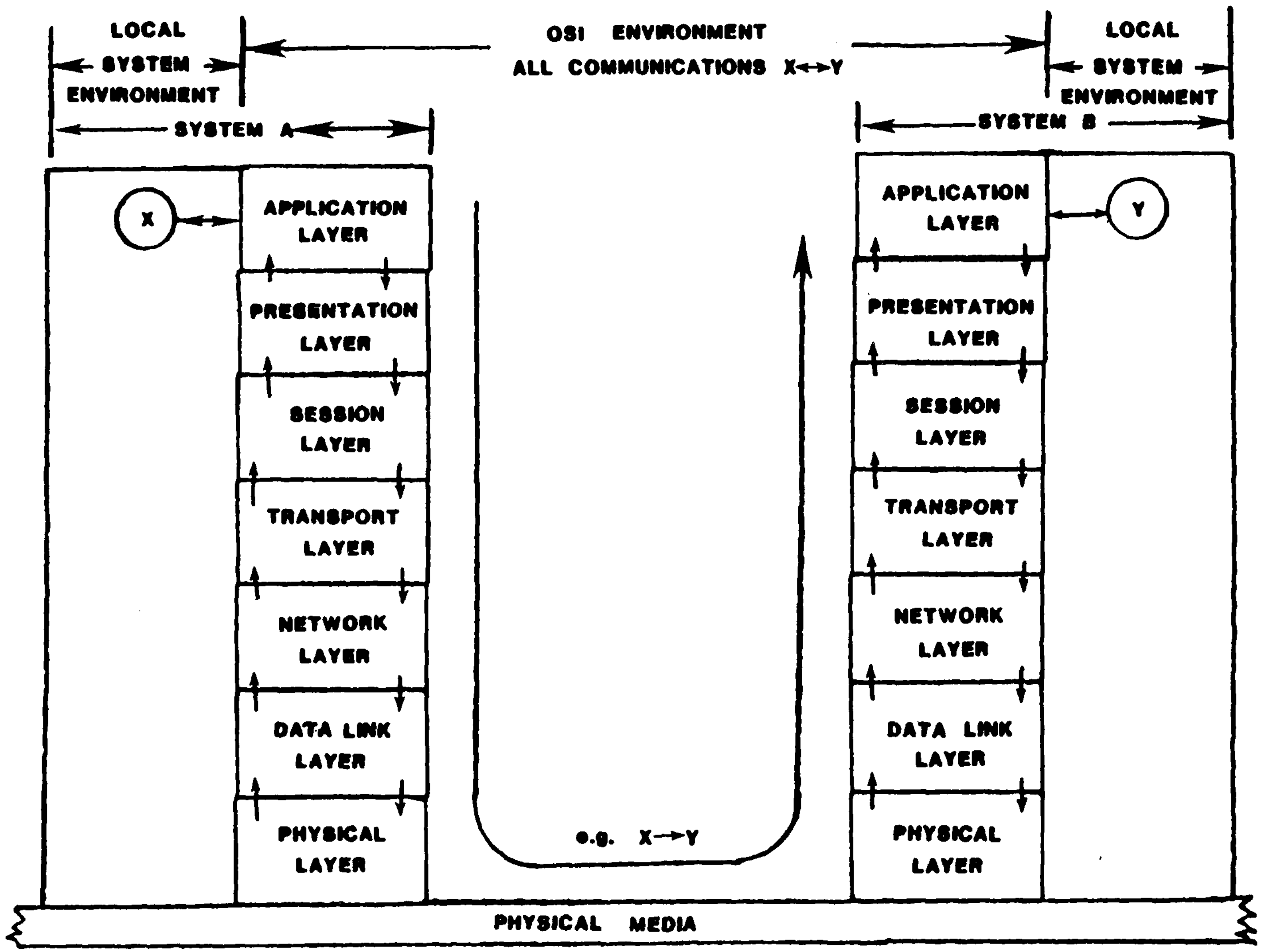

FIGURE 9. GENERAL STRUCTURE OF OSI REFERENCE MODEL

between two connected devices and to transform an unreliable transmission path into a reliable one. With the use of a data link protocol, the next higher layer may assume virtually error-free transmission over the link. However, if communication is between two systems that are connected via a network, the connection will comprise a number of data links in tandem, each functioning independently. Thus, the higher layers are not relieved of error-control responsibility.

c. Network Layer. The network layer provides upper layers with independence from the data transmission and switching technologies used to connect systems. It is responsible for establishing, maintaining, and terminating connections. The basic service of the network layer is to provide for the transparent transfer of data between transport entities. It relieves the transport layer of the need to know anything about the underlying communications medium. Thus, the layer 3 entity is responsible for invoking routing and relay functions through switched networks. When a station attaches to a network, not only must a network layer protocol be used, but the physical and data link characteristics of the [station-node] link must be specified. Thus, it is convenient to consider a set of such protocols as a network access protocol.

Internetworking. The resources of a single network are often inadequate to meet users' needs. Because the networks that might be of interest exhibit so many differences, it is impractical to consider merging them into a single network. What is needed, therefore, is the ability to interconnect various networks so that any two stations on any of the constituent networks can communicate. An interconnected set of networks is referred to as a catenet. Each constituent network supports communication among a number of attached devices. In addition, networks are connected by devices that we shall refer to generically as gateways. Gateways provide a communication path so that data can be exchanged between networks. A promising approach is the internet protocol (IP), initially developed for ARPANET. IP has been standardized by DOD. The philosophy of IP is that the gateways and stations share a common protocol for internet traffic but that the stations and networks are otherwise undisturbed. In terms of the usual open system interconnection (OSI) model for communications architecture, IP fits between the network (routing) and transport (end-to-end delivery) layers. IP makes no

assumptions about the underlying network protocol. Each host or gateway uses IP interface with its network in the same fashion as it does for intranetwork communication.

d. Transport Layer. The transport layer provides reliable, transparent transfer of data between endpoints. It provides end-to-end error recovery and flow control. The purpose of a transport protocol is to provide a reliable mechanism for the exchange of data between processes in different systems. The transport protocol ensures that data units are delivered error-free, in sequence, with no losses or duplications. The transport layer may also be concerned with optimizing the use of network service and providing a requested quality of service to session entities. For example, the session entity might specify acceptable error rates, maximum delay, priority, and security. In effect, the transport layer serves as the user's liaison with the communications facility.

e. Session Layer. The session layer provides the control structure for communications between applications. It establishes, manages, and terminates connections (sessions) between cooperating applications. The essential purpose of a session protocol is to provide a user-oriented connection service. The transport protocol is responsible for creating and maintaining a connection between endpoints. A session protocol would provide a "user interface" by "adding value" to the basic connection service.

f. Presentation Layer. The presentation layer provides independence to the application processes from differences in data representation (syntax). The presentation layer is concerned with the syntax of the data exchanged between application entities. Its purpose is to resolve differences in format and data representation. The presentation layer defines the syntax used between application entities and provides for the selection and subsequent modification of the representation to be used. Examples of presentation protocols are teletext and videotex, encryption, and virtual terminal protocol. A virtual terminal protocol converts between specific terminal characteristics and a generic or virtual model used by application programs.

g. Application Layer. The application layer provides 1) access to the OSI environment for users, 2) distributed data processing services, and 3) a means for application processes to access the OSI environment. This layer contains management functions and generally useful mechanisms to support distributed applications. Examples of protocols at this level are virtual file protocol and job transfer and manipulation protocol.

Error Control.

This section of the report deals with achieving the goal of the receiver receiving the transmission without error at the lowest overhead. The error control techniques under consideration are error detection codes, error correction codes, and retransmission. Other techniques will be adopted as required.

Several major developments have contributed to the rapid emergence of the field of error control codes over the past two decades. Externally, the cost of solid-state electronic devices has decreased almost as dramatically as their size. This has stimulated the development of digital computers and peripheral devices, and this, in turn, has caused a dramatic increase in the volume of data communicated between such machines. The intolerance of computing systems to error, and in some cases the inherently critical nature of the data, demand the use of either error-free facilities or some type of error-detecting or correcting code in the terminal devices. In many cases, the latter approach is the more economical.

There have also been significant accomplishments within the field of error control codes itself. Several classes of long, powerful codes have been devised. In addition, decoding procedures which can be implemented with a modest amount of hardware have been devised for several of these classes of codes.

These and other developments have made the use of error-control codes quite practical today in data communications systems. In the near future, the prospect is that the trends mentioned above will continue, and that error-control codes will become much more widely employed.

1. Error Detection. Because of all the different types of interference the transmission encounters on its way to the receiver, the receiver must be able to determine when an error has occurred. The error-detection technique

that could fulfill the requirements for error detection in this system is the Cyclic Redundancy Check (CRC) or the error detection capability that is an integral part of the error correction code. The error detection capability is also used in conjunction with retransmission.

2. Error Correction. It is not enough to be able to detect the errors in a transmission. All, or as many as possible, of these errors should be corrected. This requirement can be most satisfactorily fulfilled by the use of two different error-correction codes with interleaving between them. These codes will be determined during system design and testing.

There are two fundamentally different types of codes. The encoder for a block code breaks the continuous sequence of information digits into k-symbol sections or "blocks". It then operates on these blocks independently according to the particular code to be employed. With each possible information block is an associated n-tuple of channel symbols, where $n < k$. The result, now called a code word, is transmitted, corrupted by noise, and decoded independently of all other code words. The quantity n is referred to as the code length or block length.

The other type of code, called a tree code, operates on the information sequence without breaking it up into independent blocks. Rather, the encoder for a tree code processes the information continuously and associates each long (perhaps semi-infinite) information sequence with a code sequence containing somewhat more digits. The encoder breaks its input sequence into k-symbol blocks, where k is usually a small number. Then, on the basis of this k-tuple and the preceding information symbols, it emits an n-symbol section of the code sequence. The name "tree code" stems from the fact that the encoding rules for this type of code are most conveniently described by means of a tree graph.

Of the two classes of codes, the older block codes have a considerably better developed theory. The reason for this seems to be that block codes are more closely related to established, relatively well-understood mathematical structures. As a result, considerably more research has been done on them than on tree codes.

The class of convolutional codes forms a subset of the class of tree codes. These convolutional codes are important, since they are simpler to

implement than other types of tree codes. In this report, only these convolutional tree codes are considered.

Block codes and convolutional codes have similar error correcting capabilities and the same fundamental limitations. In particular, Shannon's fundamental theorem for the discrete noisy channel holds for both types of codes. This result states that a channel has a well-defined capacity and that by using suitable codes, it is possible to transmit information at any rate less than channel capacity with arbitrarily small probability of decoding erroneously.

The names of some representative block codes are Hamming, Reed-Solomon, and Bose-Chaudhuri-Hocquenghem (BCH). The name of a representative convolutional code technique is the Viterbi decoder.

(a) Hamming. The Hamming code is a linear block code. It is represented as Hamming (n, k) where n is equal to the number of output bits in the block and k is equal to the number of input bits in the block. The code rate is represented by k/n, and (1-(k/n)) is the overhead. Another parameter, t, is how many errors are correctable in a given block, and t/n represents the fraction of what you transmit that is correctible (i.e. the error correcting capability). For example, Hamming (15,7) corrects two errors and t/n equals 2/15. Hamming (31,16) corrects three errors and t/n equals 3/31. Hamming (63,30) corrects six errors and t/n equals 6/63. Hamming (127,64) corrects ten errors and t/n equals 10/127. From this, you can see the bigger Hamming codes give you worse error correcting capabilities, although the Hamming code is simple to implement.

(b) Reed-Solomon. The Reed-Solomon code is a non-binary BCH code. It is a cyclic, linear block code. It is represented by Reed-Solomon (n,k) t,m where n equals the number of output symbols and k equals the number of input symbols; t is the number of errors you can correct in a given block, and m is the number of bits in a symbol (or the degree of primitive polynomial). Typically, m is four to eight bits. For example, Reed-Solomon (15,7) can correct four symbol errors or, in this case, where m equals four, it can correct 16 bit errors per block of 60 bits. This specific code can also detect 32 bit errors out of this block of 60 bits. For a given rate, the Reed-Solomon code's error correcting capability (t/n) is fixed. For a rate 1/2, t/n is

approximately .05. The Reed-Solomon is an excellent error control code and is significantly better than the Hamming code but requires more computation.

(c) Viterbi. The Viterbi decoder is represented as Viterbi (n,k)K, where n and k give you the ratio k/n (or code rate) and K is the constraint length. For example, Viterbi (4,3)2 can correct two errors in a run of 8 bits. Another example, Viterbi (2,1)7 can correct four errors in a run of 14 bits. The constraint length means how long a given input will contribute to the given output. The Viterbi decoder and its associated convolutional encoder are a convolutional code and are in the same category of excellence as the Reed-Solomon code, but in this case, instead of requiring more computations, it requires more memory.

(d) Interleaving. Interleaving is an excellent technique to counter long burst errors. It is used in conjunction with an outer and inner error control code. In essence, the data is encoded by the outer code, loaded into memory by rows, retrieved from this memory by column, encoded by the inner code, transmitted, received, decoded by the inner code and stored in memory by column. It is then read out of memory by row and finally decoded by the outer code. A block diagram of concatenated (that is, linked together as in a chain) inner and outer error control codes with interleaving to achieve a large error-correcting capability is represented in Figure 10.

3. Retransmission. In the event the error-correction codes cannot correct all of the errors, the message can be retransmitted. This retransmission could also include lowering the transmission speed. Other techniques may be required in cases of extreme noise or extreme fading.

4. Radio Frequency Effects. At HF, signal fading is a significant problem. Lightning bursts are also significant. Both of these effects cause long burst errors. At VHF, some of the causes of errors are fading, noise bursts and terrain attenuation. At UHF LOS, some of the causes of errors are thermal noise, weather attenuation (for example, rain), and terrain attenuation. At UHF [SATCOM], some of the causes of errors are thermal noise and wind loading on the antenna.

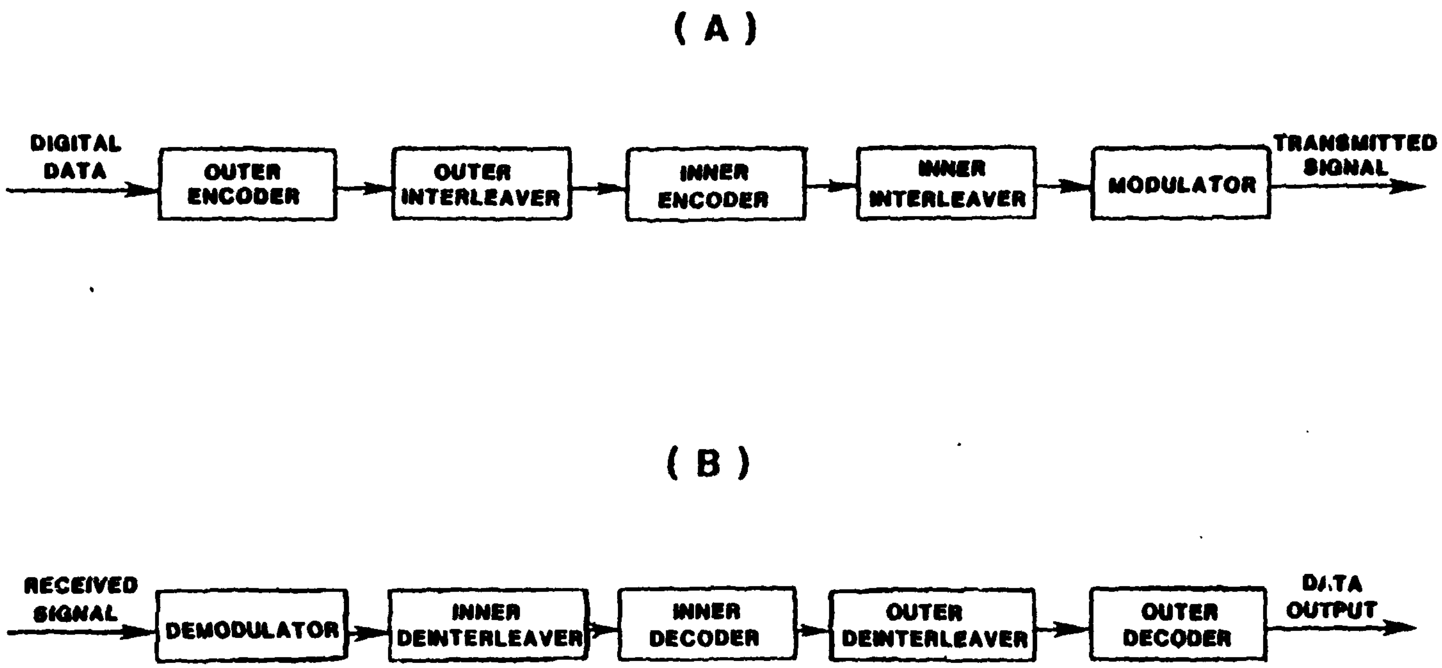

FIGURE 10. CONCATENATED CODING: (A) TRANSMITTER AND (B) RECEIVER

5. Conclusions. The radio frequency effects the low error rate requirements of the computers, and the need to counter other forms of interference, for example jamming, place heavy demands on the error control function. Also, for the same fraction or percentage of overhead (e.g., at a rate of 1/2 the overhead is 1/2 or 50%), the Reed-Solomon (15,7) code can correct more than twice as many errors as the equivalent Hamming code. Another consideration is to know when an error control code is detrimental (e.g., at very low SNR). It is essential that optimal signal processing is done before decoding.

Therefore, the best prediction of what will be needed is two strong error correcting codes for the outer and inner encoders/decoders such as the Reed-Solomon code and the Viterbi code, and an interleaving capability that will encompass an expected worst case burst of errors. In the low probability cases where this error control capability is exceeded, retransmission can be applied. Also, a mechanism is needed to determine when the error control coding is detrimental and when to take the necessary action(s).

Secure Communications

Secure communications are achieved through the use of cryptographic equipment. Representative examples of this cryptographic equipment are KY-57, KY-58 and KG-84. This equipment is capable of enciphering and deciphering digital transmissions. In the following paragraphs, red side refers to the plain (unencrypted) text side, and black side refers to the cipher (encrypted) text side.

1. KY-57 and KY-58. The KY-57 is the primary cryptographic equipment used by the Marine Corps at VHF and UHF. The KY-58 is the shipboard version of the KY-57. The interconnections of the KY-57 with the computer/JKF Box combination on the red side and the radio on the black side are depicted in Figures 11 and 12. The KY-57 can encrypt digital data. It operates in a half-duplex push-to-talk mode at 8 or 16 kilobits per second. It can interface directly with many radios operating at the VHF and UHF frequencies, with amplitude modulation (AM) or frequency modulation (FM). FM uses the baseband cipher text format. AM uses the diphase cipher text format. These formats will be explained later.

2. KG-84. The KG-84 is the primary HF cryptographic equipment used in the Marine Corps. The interconnections of the KG-84 with the computer/JKF Box on the red side and the radio on the black side are represented in Figures 13

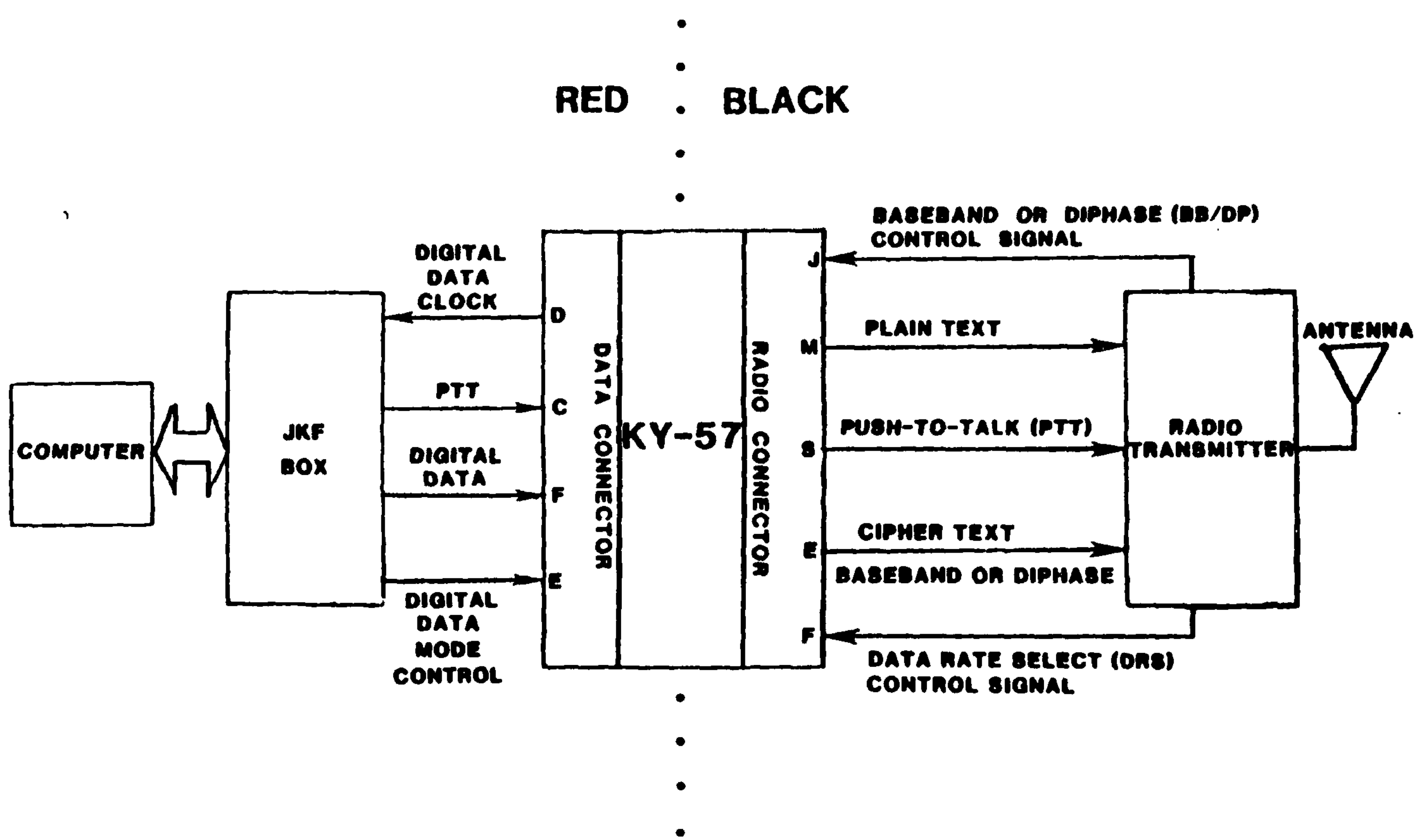

FIGURE 11. KY-57 TRANSMITTER MODE

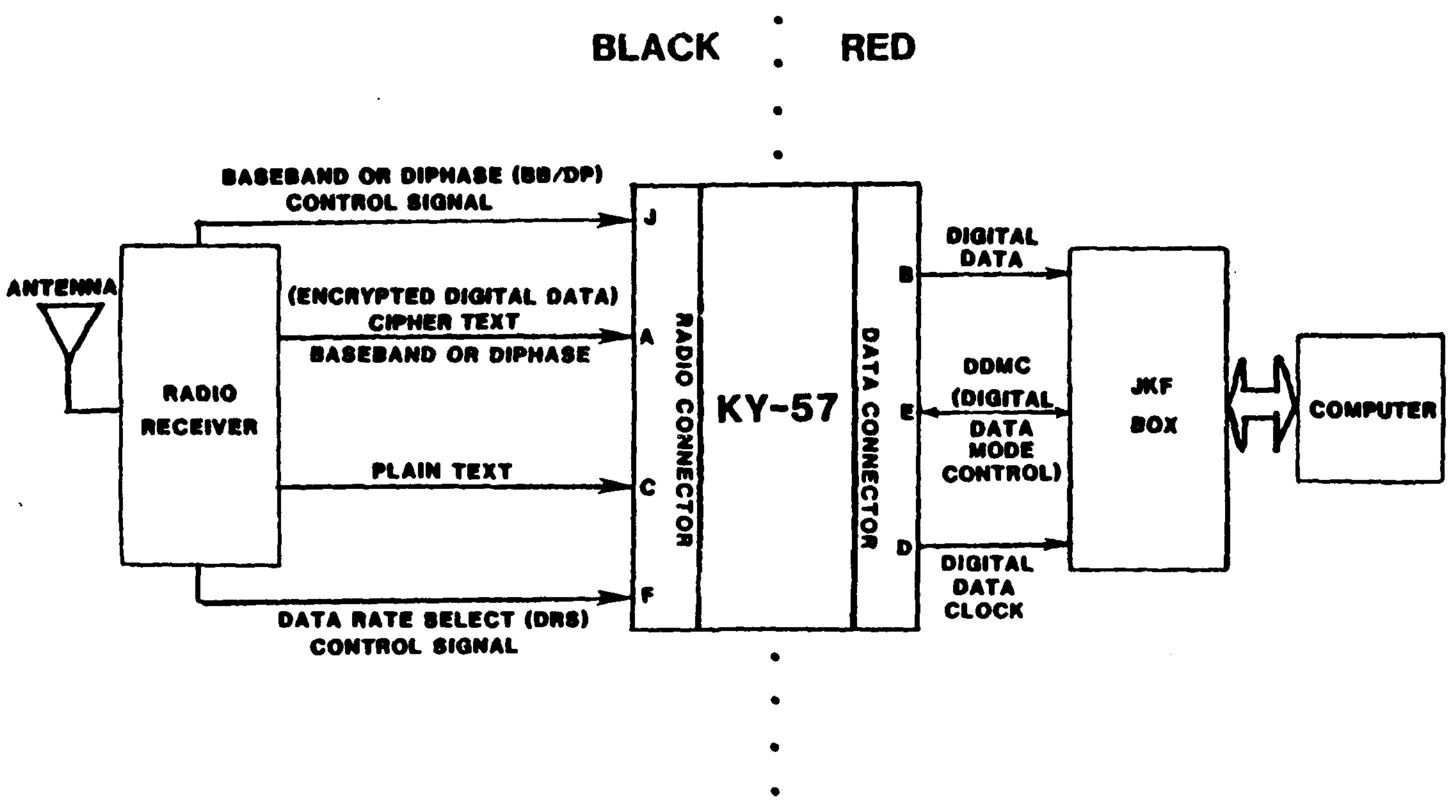

FIGURE 12. KY-57 RECEIVER MODE

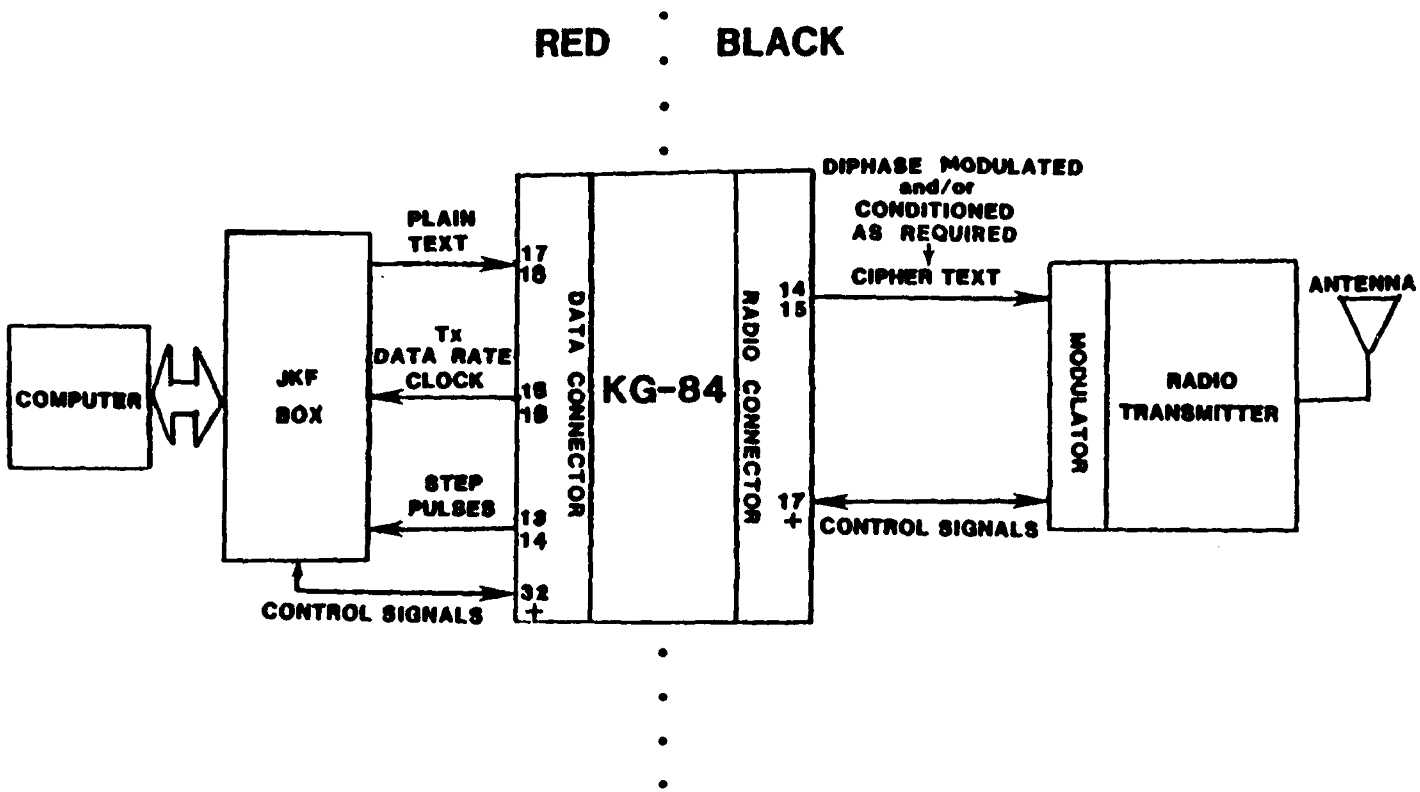

FIGURE 13. KG-84 TRANSMITTER MODE

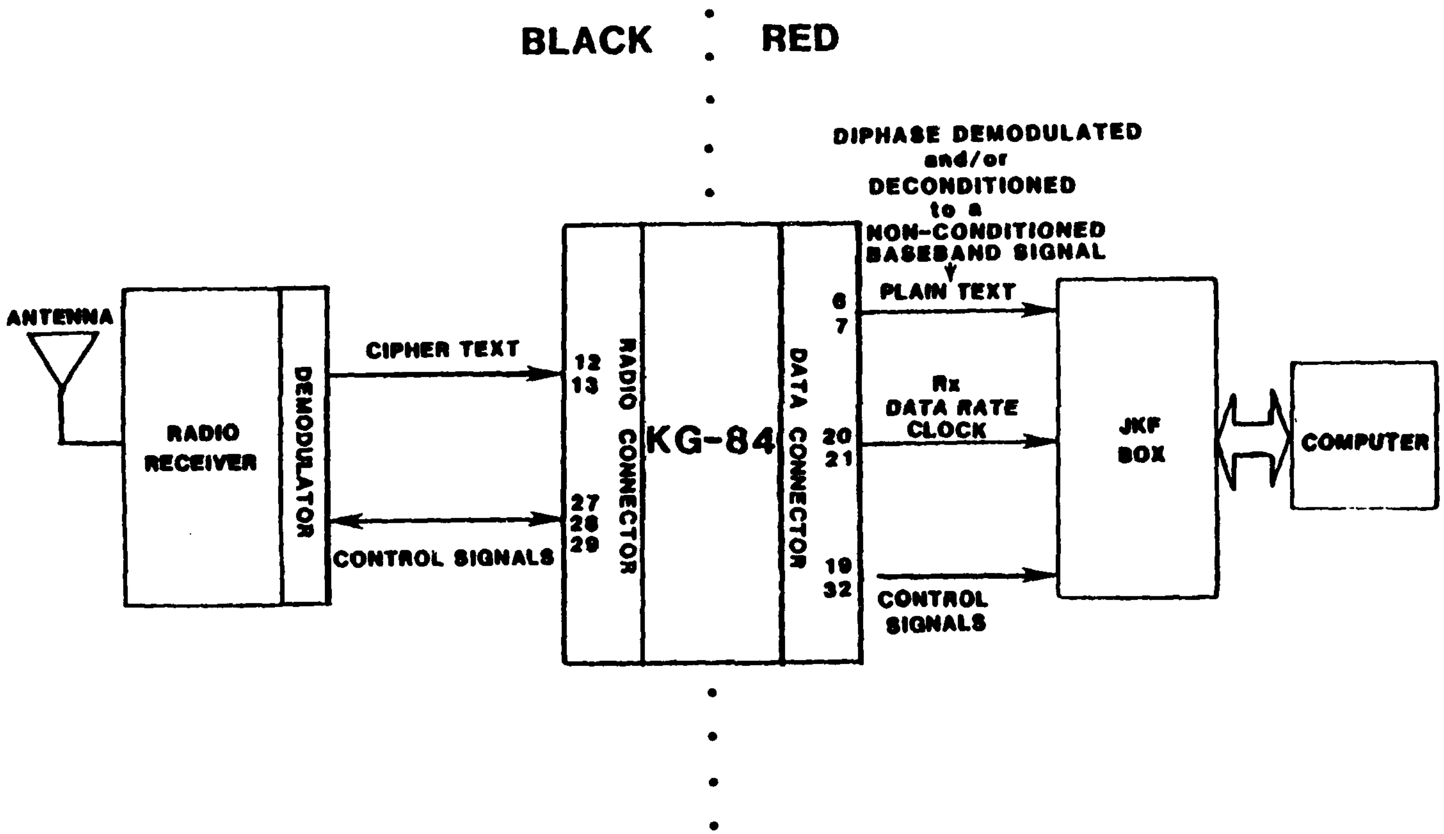

FIGURE 14. KG-84 RECEIVER MODE

and 14. The KG-84's asynchronous data traffic is TTY traffic of ITA format no. 2 (5 level); or TTY traffic of ITA format no. 5 (8 level), having one start bit and one or two stop bits. The data rate can be any of twelve, selectable from 50 to 9600 bits/second. The KG-84's synchronous data traffic's data rate can be any of twelve, selectable. Using external clock, it can be up to 64 kb/s. The KG-84's communications (traffic) mode options are: (a) full duplex (dedicated loop); (b) independent duplex (Tx and Rx can be at different data rates); (c) Tx only; (d) Rx only; and (e) simplex. Note that Tx clock can be continuous or can be gated by Tx ready status (strap option).

The KG-84's data modes (signal structure) are: (a) baseband (voltage level identifies information of signal--one or zero); (b) diphase (modulation of baseband signal with a data rate squarewave); (c) wireline (diphase); (d) conditioned baseband (information contained in transitions of waveform) with one being a change in level at clock pulse and zero being no change in level at clock pulse; (e) conditioned diphase (modulation of conditioned baseband signal with a data rate squarewave); and (f) conditioned wireline (conditioned diphase). The KG-84's data clock rates and modes are as follows:

(a) data may be phased to an internal clock at 14 selectable data rates of 50, 75, 100, 110, 150, 300, 600, 1200, 2400, 4800, 8000, 9600, 16000, and 32000 bits/second (b/s or baud rate). The Tx clock can be independent of, or slaved to, the Rx clock in this mode.

(b) data may be phased to some external 32X data rate clock input at any data rate of up to 32 kb/s (external clock input of 1.024 MHz). Tx clock can be independent of, or slaved to, the Rx clock in this mode.

(c) data may be phased to some external data rate clock input at any rate of up to 64 kb/s; however, only synchronous conditioned baseband data can be processed when using this provision. The Tx and Rx clocks are independent.

Every communicator on the medical communications network must have the proper cryptographic equipment and associated keys for this equipment. The communicators will follow standard crypto procedures as described in the KAM manuals. Examples of the baseband, diphase, conditioned baseband, and conditioned diphase signals are represented in Figure 15.

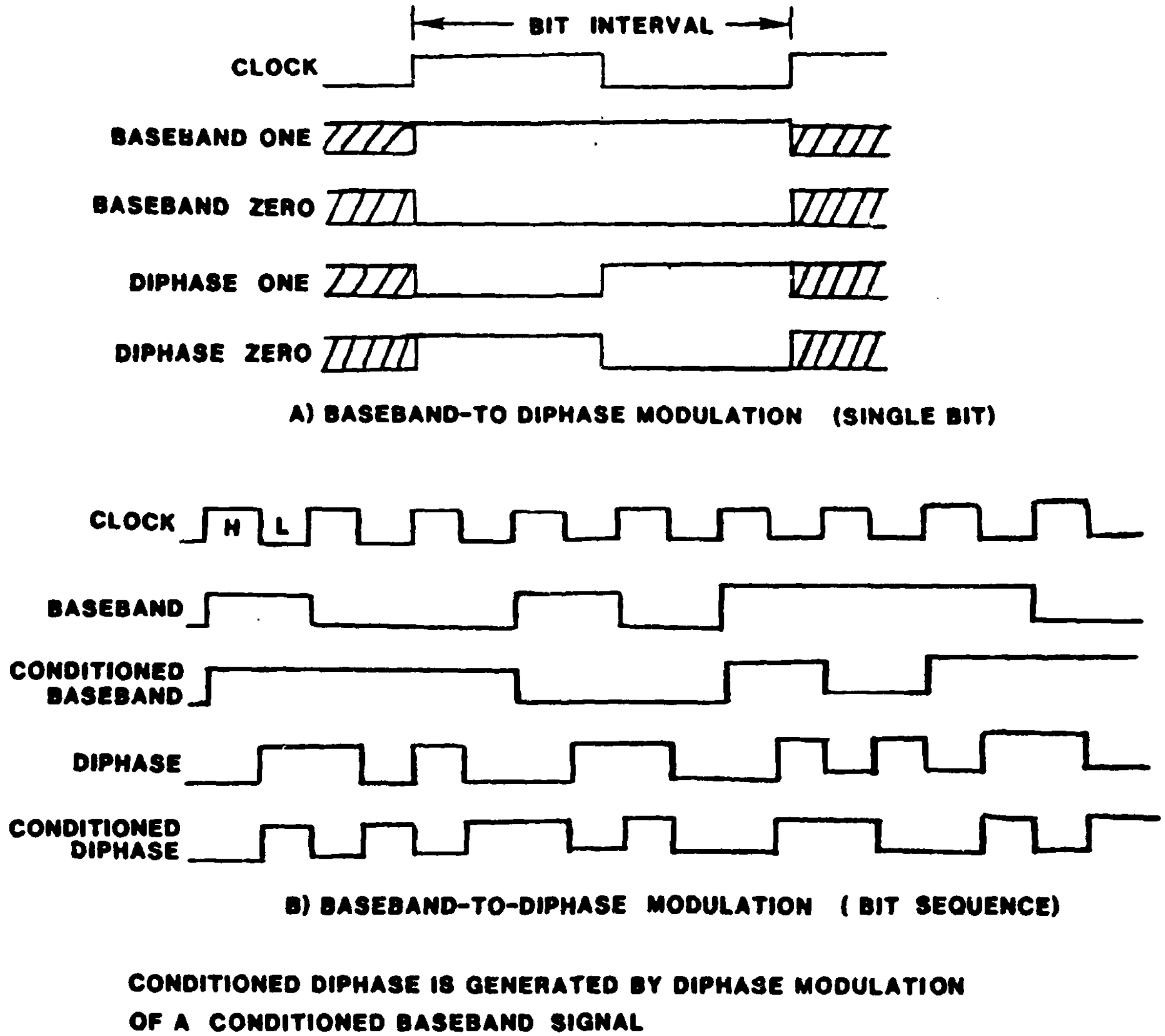

FIGURE 15. BASEBAND, DIPHASE, CONDITIONED BASEBAND, AND CONDITIONED DIPHASE SIGNALS

JFK Box.

This box is designed to fulfill all of the error control requirements of the computer communications architecture. It also fulfills all of the requirements of interfaces between the computer in the local area networks (LANs) and the receivers and transmitters and their associated cryptographic equipment. The preliminary design of this box indicates that one possible implementation will be one PC board plus the software to run it.

A major design consideration is to move the error control coding function between the cryptographic equipment and the radio, in contrast to the current placement of the error control coding function between the computer and the cryptographic equipment. The justification for this is that the error control coding will be more effective in reference to the total communications system operation if the encoding is done after the enciphering at the transmitter site, and the errors are corrected by the decoding function at the receiver site before the data reaches the cryptographic equipment. This configuration is illustrated in Figure 16.

Inputs. The inputs to the JKF Box when the computer is transmitting data are the RS232C interface outputs from the computer. The inputs to the JKF Box when the computer is receiving data are via the radio receiver and associated cryptographic equipment. This is in a MIL STD 188 series protocol in an encoded form. The JKF Box will accept the crypto clock and use it to clock data into and out of the computer.

Processing. The JKF Box will translate the RS232C interface to the compatible MIL STD 188 series interface and will translate the MIL STD 188 series interface to the RS232C interface. The JKF Box will also perform the functions of error control coding. This includes the error control coding of the outer and inner encoders and decoders. This error control coding will also include the interleaving and deinterleaving. The JKF Box will reconfigure itself dependent on what computer, radio, cryptographic equipment and what data rates are being used. The JKF Box will manage the operation of these functions.

Outputs. The outputs of the JKF Box when the computer is receiving data are in the form of the RS232C interface that is decoded. The output of the

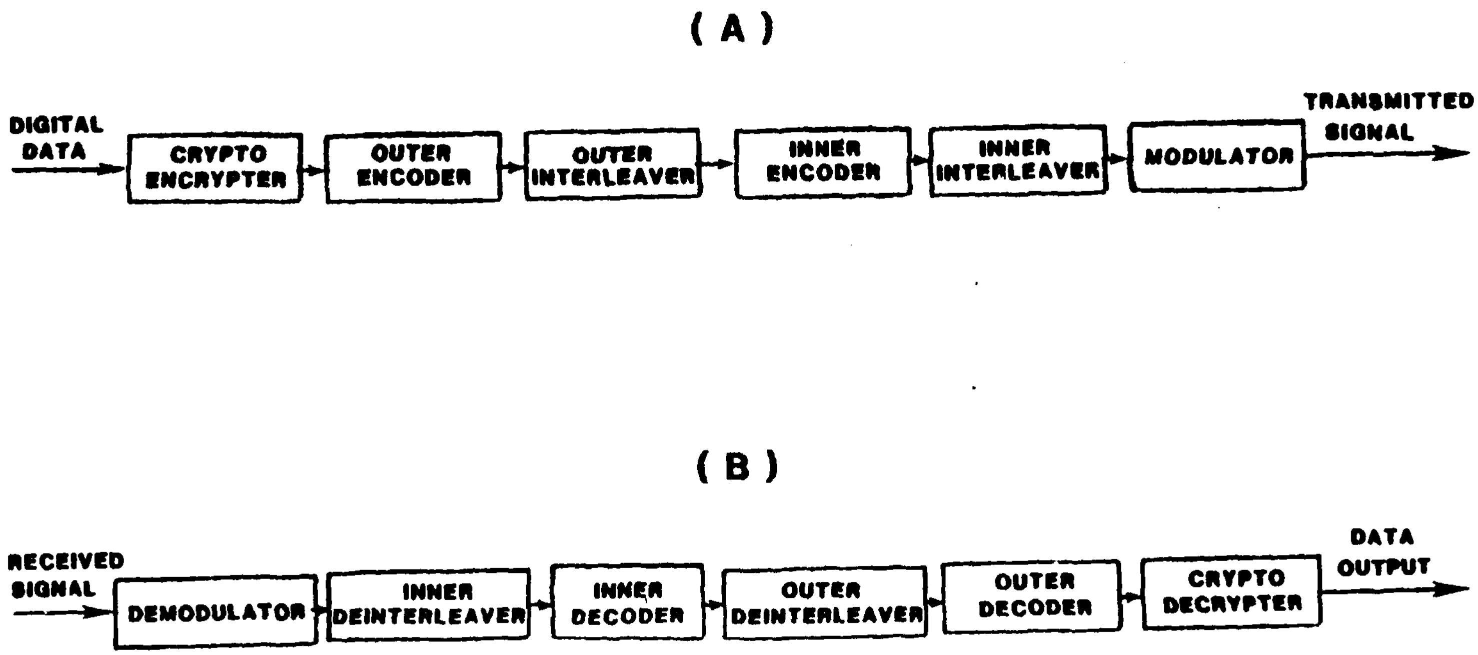

FIGURE 16. ENCRYPT - ENCODE - DECODE - DECRYPT SEQUENCE

Box, when the computer is transmitting data, is in the MIL STD 188 series protocol, in an encoded form. The JKF Box will generate the necessary control signals for the cryptographic equipment and the radios.

Hardware. The preliminary design indicates that the hardware could be one printed circuit card plugged into the computer in one of the expansion slots, or in a stand-alone box.

Software. The preliminary design indicates that the software would be written in Turbo-Pascal, Common Lisp and some I/O in Assembler. The operating system would be MS-DOS.

Communications with Theater Army Medical Management Information System (TAMMIS).

The TAMMIS system is used down to the division level in the Army. TAMMIS performs functions in medical logistics, blood management, patient regulating, and patient accounting and reporting. TAMMIS-D is used from the Division level down to the front-line troops. TAMMIS and TAMMIS-D are presently under development.

Communication Interface. The computer for TAMMIS is the TACCs (Tactical Army Combat Service Support Computer), a Burroughs B-26. The computer used in TAMMIS-D is the Unit Level Computer (ULC). This computer has not been selected yet. TAMMIS has plans to use land lines and radio, but these capabilities are presently not completed.

Communications Procedure. The only procedure presently available is floppy disk by courier.

Communications with the U.S. Air Force (USAF)

At present, there is no interface of this system with the U.S. Air Force medical capabilities.

RADIO COMMUNICATIONS

This section of the report discusses Radio Communications. It starts with a discussion of modulation and is followed by a discussion of radio waves. Then there is a discussion of representative communications equipment used to implement the Radio Communications. This section ends with a discussion of connectivity and other communication techniques.

Modulation of a Sine Wave Carrier.

Modulation and its inverse, demodulation, are functions performed in the radio by modulators and demodulators. There are two main purposes in using modulators-demodulators (modems). First, they increase the possible speed over a given circuit. Second, they reduce the effects of noise and distortion. Many communication links would be unusable at reasonable speeds without modulation.

The majority of modems in operation transmit a continuous sine wave carrier. They modulate this carrier in accordance with the data that are to be sent. The sine wave has three parameters that can be modulated: its amplitude, its frequency, and its phase. Thus, there are three basic types of modulation. Each of these methods is in common use today. The sine wave carrier may be represented by:

$$a = A \sin (2\pi ft + \theta)$$

where: a = the instantaneous amplitude of carrier voltage at time t

A = the maximum amplitude of carrier voltage

f = the carrier frequency

θ = the phase

The values of A, F, or θ may be varied to make the wave carry information. All three modulation methods are shown in Figure 17, where a sinusoidal carrier wave of 1500 Hz, for example, is modulated to carry the information bits 01000101100.

In the top diagram of Figure 17, the amplitude is varied in accordance with the bit pattern. In the middle diagram, the frequency is varied; and in the bottom one, the phase is varied. Many variations are possible within these three main types of modulation.

The inverse of modulation, called demodulation, is accomplished at the receiving end of the communications link in order to recover the information bits.

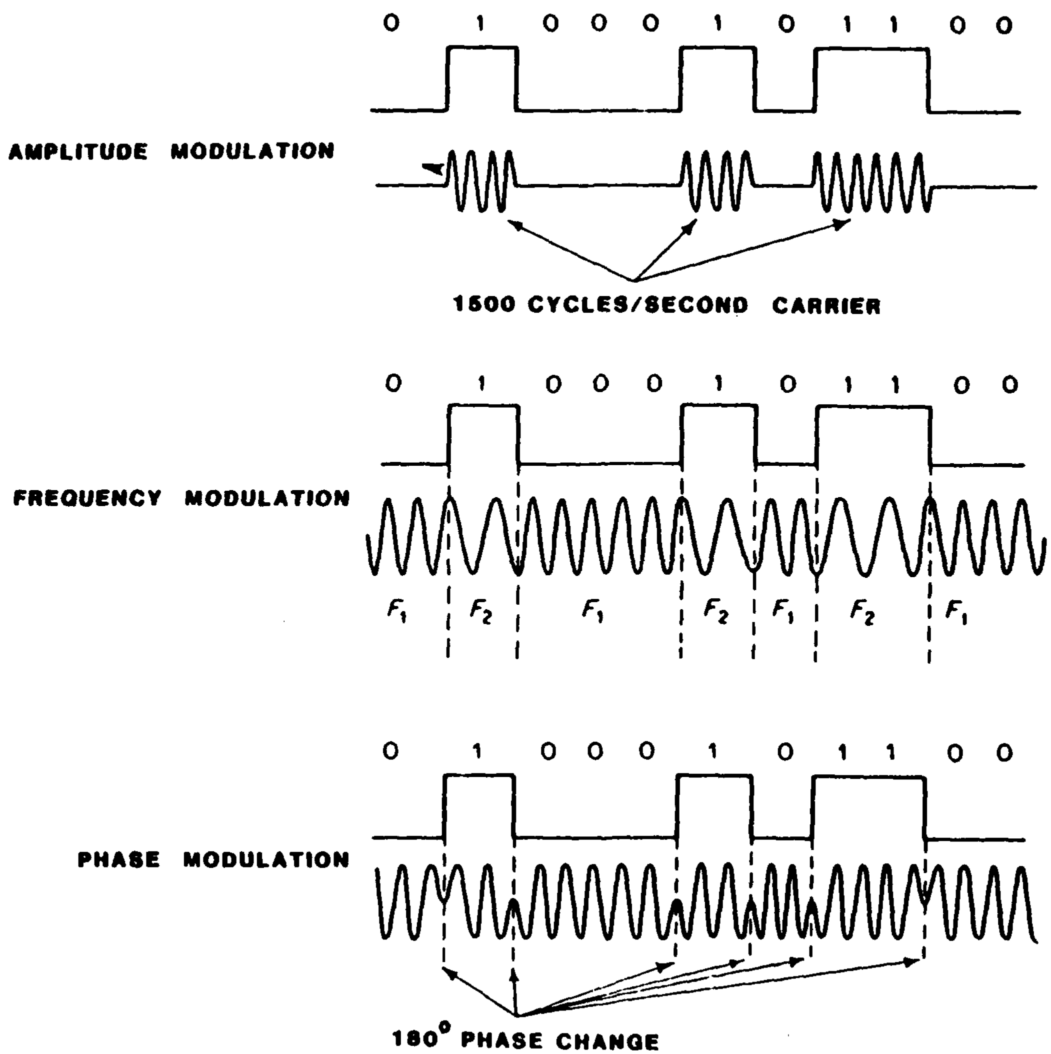

FIGURE 17. THE THREE BASIC METHODS OF MODULATING A SINE WAVE CARRIER (A SIMPLIFIED DIAGRAM SHOWING ONLY BINARY SIGNALS)

Radio Waves.

Radio waves are perhaps best conceived as energy that has been emitted into space. The energy exists partly in the form of an electric field and partly in the form of a magnetic field. For this reason, the waves are called "electromagnetic".

In several important respects, the two types of fields are inextricably interrelated. For an electric current to flow, an electric field must exist; and whenever an electric current flows, a magnetic field is produced.

If the fields vary with time, the interrelationship extends further. Any change in a magnetic field (increase or decrease in magnitude or movement relative to the observer) produces an electric field. Similarly, any change in an electric field produces a magnetic field.

The dynamic relationship between the electric and magnetic fields is what gives rise to electromagnetic waves. Because of this relationship, whenever a charge such as that carried by an electron accelerates (changes the direction or rate of its motion, hence changes the surrounding fields), electromagnetic energy is radiated. The change in the motion of the charge causes a change in the surrounding magnetic field that is produced by the particle's motion. That change produces a changing electric field a bit further out, which in turn produces a changing magnetic field just beyond it, and so on. By thus mutually interchanging energy, the electric and magnetic fields propagate outward from the antenna.

Characteristics of Radio Waves. A radio wave has several fundamental characteristics: speed, direction, polarization, intensity, wavelength, frequency, and phase.

1. Speed. In a vacuum, radio waves travel at constant speed: the speed of light. In the troposphere, they travel a little slower. Moreover, their speed varies slightly not only with the composition of the atmosphere, but with its temperature and pressure. The variation, however, is so small that for most practical purposes radio waves can be assumed to travel at a constant speed, the same as that in a vacuum. This speed is very nearly equal to 300,000,000 meters per second.

2. Direction. This is the direction in which a wave travels: the direction of propagation. It is perpendicular to the directions of both the electric and the magnetic fields. These directions are always such that the direction of propagation is away from the radiator.

3. Polarization. This is the term used to express the orientation of the wave's fields. By convention, it is taken as the direction of the electric field. When the electric field is vertical, the wave is said to be vertically polarized. When the electric field is horizontal, the wave is said to be horizontallly polarized. A receiving antenna placed in the path of a wave can extract the maximum amount of energy from it if the polarization (orientation) of the antenna and the polarization of the wave are the same. If the polarizations are not the same, the extracted energy is reduced in proportion to the cosine of the angle between them.

4. Intensity. This is the term for the rate at which a radio wave carries energy through space. It is defined as the amount of energy flowing per second through a unit of area in a plane normal to the direction of propagation. The intensity is directly related to the strengths of the electric and magnetic fields. Its instantaneous value equals the product of the strengths of the two fields times the sine of the angle between them. In free space outside the immediate vicinity of the antenna, the angle is 90 degrees; so the intensity is simply the product of the two field strengths. Generally, what is of interest to us is not the instantaneous value of the intensity but the average value. If an antenna is interposed at some point in a wave's path, for example, multiplying the wave's average intensity at that point by the area of the antenna gives the amount of energy per second intercepted by the antenna. In considering the transmission and reception of radio waves, the term "power density" is often used for the wave's average intensity. (The two terms are equivalent.) The power of the received signal, then, is the power density of the intercepted wave times the area of the antenna.

5. Wavelength. If we could freeze a linearly polarized radio wave and view its two fields from a distance, we would observe two things. First, the strength of the fields varies cyclically in the direction of the wave's travel. It builds up gradually from zero to its maximum value, returns gradually

to zero, builds up its maximum value again, and so on. (The fields in the planes of two successive maxima are shown in Figure 18.) Second, we would see that each time the intensity goes through zero, the directions of both fields reverse. The distance between successive points at which the intensity of the field goes through zero in the same direction is the wavelength.

6. Frequency. Since a radio wave travels at a constant speed, its frequency is inversely proportional to its wavelength. The shorter the wavelength (the more closely spaced the crests) the greater the number of them that will pass a given point in a given period of time; hence, the greater the frequency. Another measure of frequency is period. It is the length of time a wave or signal takes to complete one cycle.

7. Phase. A concept that is essential to understanding many aspects of radio operation is phase. Phase is the degree to which the individual cycles of a wave or signal coincide with those of a reference of the same frequency. Phase is commonly defined in terms of the points in time at which the amplitude of a signal goes through zero in a positive direction. The signal's phase, then, is the amount that these *zero-crossings* lead or lag the corresponding points in the reference signal of the same frequency. It is commonly expressed in degrees.

Communications Equipment.

The following information is a brief introduction to the equipment that could be used to communicate medical data from one medical treatment facility to another during an amphibious operation and during the subsequent operations ashore. The presentation of the information in this section will be in the form of block diagrams. The first part of the section discusses communications in the high frequency (HF) range. The second part of this section discusses communications in the very high frequency (VHF) range. The third part of this section discusses communications in the ultra high frequency (UHF) range for both line-of-sight (LOS) and satellite communications (SATCOM). The last part of this section is a general discussion of connectivity, followed by a discussion of other techniques.

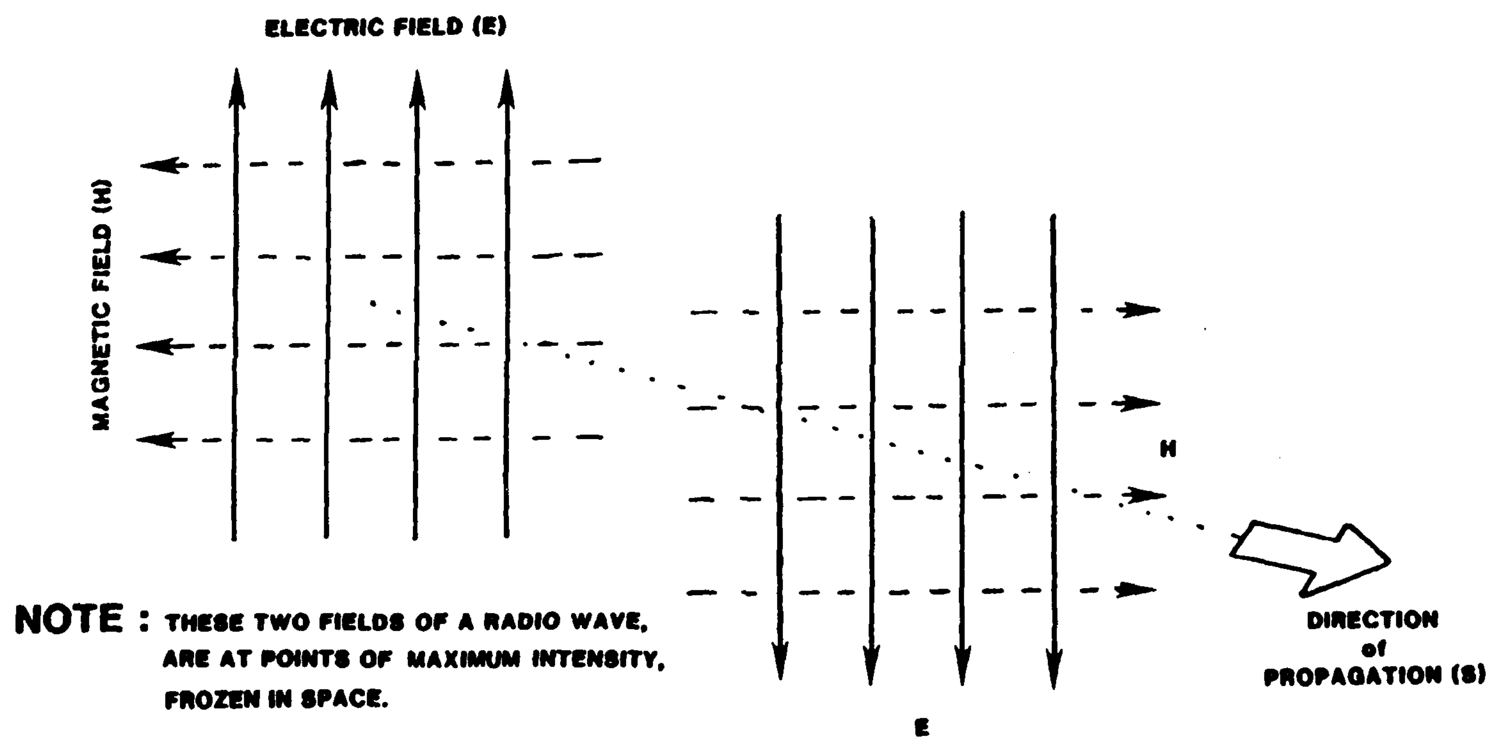

FIGURE 18. RELATIONSHIP OF ELECTRIC FIELD, MAGNETIC FIELD, AND DIRECTION OF PROPAGATION OF ELECTROMAGNETIC WAVE

The basic communications system configuration is the same for all of the frequency ranges. The differences are in the type of crypto unit, radio, and antenna used and the distance of transmission.

The following two paragraphs describe, in general terms, the operation of the communication systems. The signal flow in these communication systems is in both directions. For the purpose of this description, the signal flows from the left side of the diagram to the right side of the diagram.

The data to be transmitted is first entered into the microcomputer by an operator. From there the data is transferred to the "JKF Box". The JKF Box performs the function of an interface between a microcomputer, the crypto unit, and the following transmitter, plus additional functions. The data is then transferred to the crypto unit where it is encrypted. From here, the data is transferred to modulate the transmitter. This data modulated signal is then amplified and increased to the transmitter carrier frequency and transferred to the antenna for transmission.

The signal is then transmitted on the communications net to which other communications facilities are connected. The signal is received by the antenna connected to the receiver where it is amplified and demodulated. The data is then transferred to the crypto unit, where it is decrypted. The data is then fed to the JKF Box which in turn interfaces with the microcomputer where the operator reads the data and uses it.

Proviso: The equipment in the following sections is representative of that which is presently used in the Marine Corps. In any case, where there are alternative equipment configurations or as new equipment is introduced, the same general principles of this report apply. The following table gives an explanation of what the nomenclatures mean that are depicted in the following communications block diagrams for HF, VHF, UHF LOS, and UHF SATCOM. The nomenclatures in the block diagrams have the prefix A/N deleted.

TABLE 1. COMMUNICATIONS EQUIPMENT

NOMENCLATURE	EXPLANATION
AN/GRC-160	VHF Ground Radio Transmitter/Receiver (includes PRC-77)
AN/KG-84	Cryptographic Equipment Used at HF
AN/KY-57	Ground Cryptographic Equipment Used at VHF/UHF
AN/KY-58	Shipboard Cryptographic Equipment Used at VHF/UHF
AN/PRC-104	HF Ground Radio Transmitter/Receiver
AN/PS-3	UHF Ground Radio Transmitter/Receiver
AN/R-1051	HF Shipboard Receiver
AN/URT-23	HF Shipboard Transmitter
AN/VRC-12	VHF Ground Transmitter/Receiver
AN/VRC-46	VHF Transmitter/Receiver
AN/WSC-3	UHF Shipboard Transmitter/Receiver

Frequency Ranges.

The following sections cover items related to communications in specific frequency ranges.

1. High Frequency (HF) Communications. This section will cover the items related to communications in the HF frequency range.

a. Medium Interaction at HF. In the HF frequency range, the signals follow a ground path and a sky path. The sky path is a result of refraction from the ionosphere. The ionosphere is composed of different layers that vary depending on the time of day. Although communications can be achieved at greater ranges than LOS, it is also subject to fading.

b. Block Diagrams. The first block diagram (Figure 19) represents the Ship-to-Ship communications. The second block diagram (Figure 20) represents the Ship-to-Shore communications. The third block diagram (Figure 21) represents the Shore-to-Shore communications.

c. Interface. The interface is the MIL STD 188 series.

d. Transmission Modes. The representative transmission mode will be frequency shift keying (FSK).

2. Very High Frequency (VHF) Communications. This section will cover the items related to communications in the VHF frequency range.

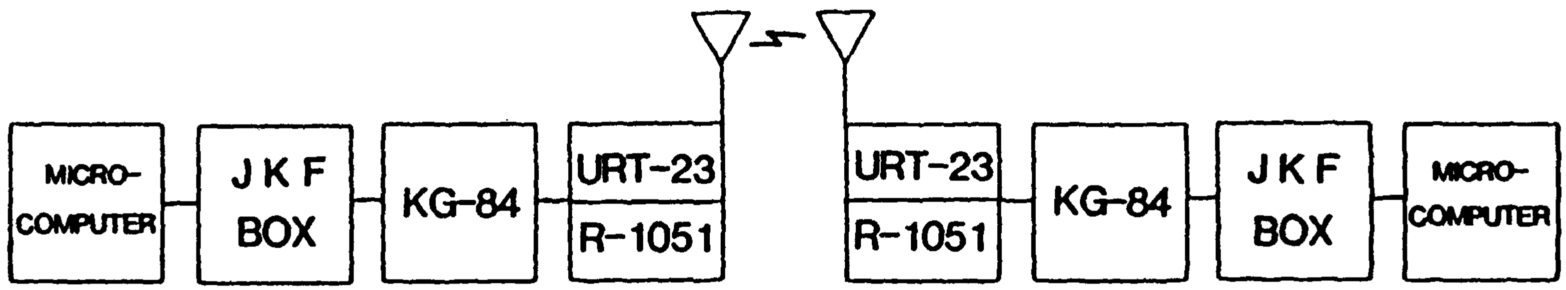

FIGURE 19. SHIP TO SHIP HF COMMUNICATIONS SYSTEM

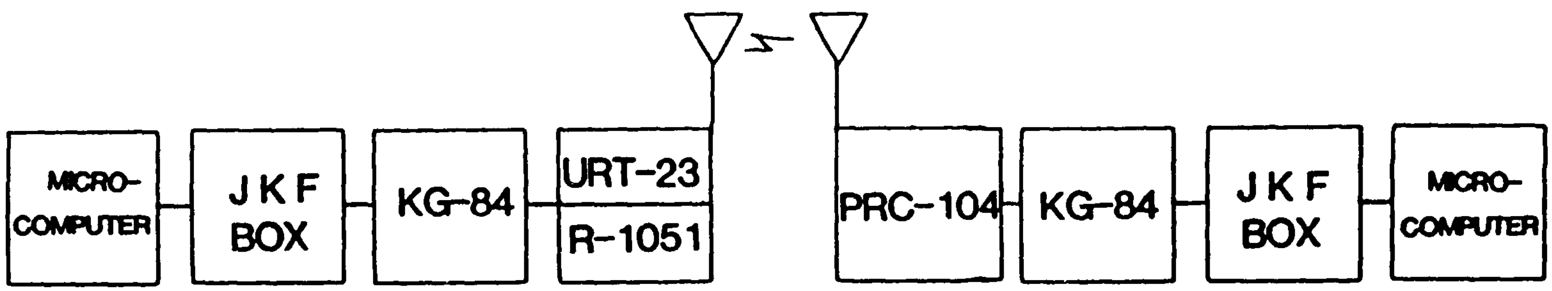

FIGURE 20. SHIP TO SHORE HF COMMUNICATIONS SYSTEM

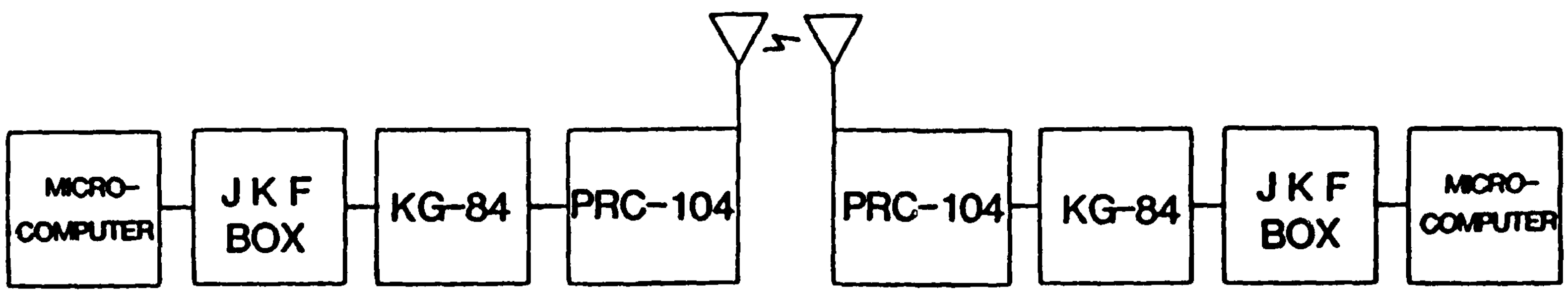

FIGURE 21. SHORE TO SHORE HF COMMUNICATIONS SYSTEM

a. Medium Interaction at VHF. The propagation path at VHF is slightly beyond LOS because of refraction. This can be shortened by terrain and weather.

b. Block Diagrams. The first block diagram (Figure 22) represents Ship-to-Ship communications. The second block diagram (Figure 23) represents the Ship-to-Shore communications. The third block diagram (Figure 24) represents the Shore-to-Shore communications.

c. Interface. The interface is the MIL STD 188 series.

d. Transmission Modes. The representative mode of transmission is frequency shift keying (FSK).

3. Ultra High Frequency (UHF) Communications (LOS AND SATCOM). Although the propagation path for UHF SATCOM is LOS, SATCOM has unique requirements that make it a separate category.

a. Medium Interaction at UHF LOS. The propagation path for UHF is slightly beyond LOS because of refraction. This range may be shortened because of terrain and weather.

b. Medium Interaction at UHF SATCOM. The propagation path at UHF SATCOM is uplink to the satellite or satellite network and downlink to the ground SATCOM receiver.

c. Block Diagrams. The first block diagram (Figure 25) represents the Ship-to-Ship communications. The second block diagram (Figure 26) represents the Ship-to-Satellite-to-Ship communications. The third block diagram (Figure 27) represents the Ship-to-Shore communications. The fourth block diagram (Figure 28) represents the Ship-to-Satellite-to-Shore communications. The fifth block diagram (Figure 29) represents the Shore-to-Shore communications. The sixth block diagram (Figure 30) represents the Shore-to-Satellite-to-Shore communications.

d. Interfaces. The interface for UHF LOS and SATCOM is the MIL STD 188 series.

e. Transmission Modes. The primary transmission mode for UHF is phase shift keying (PSK).

Connectivity. A representative scenario for the connectivity is as follows:

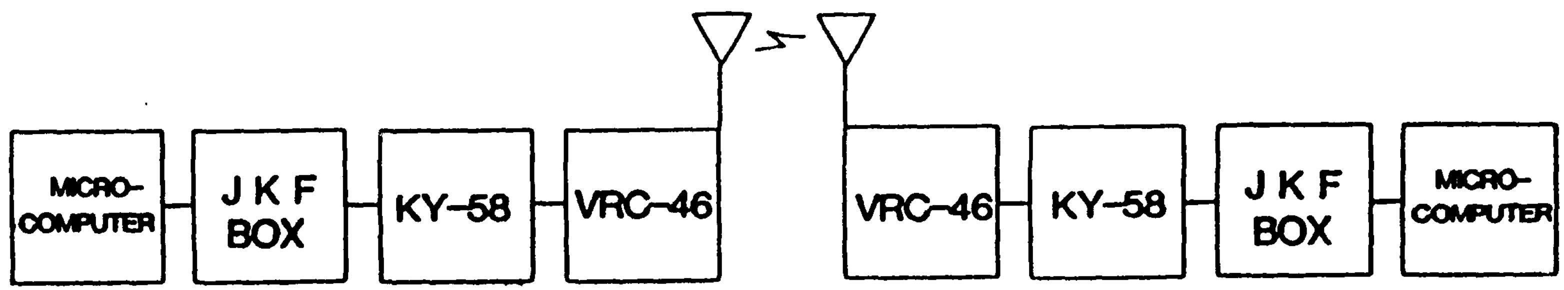

FIGURE 22. SHIP TO SHIP VHF COMMUNICATIONS SYSTEM

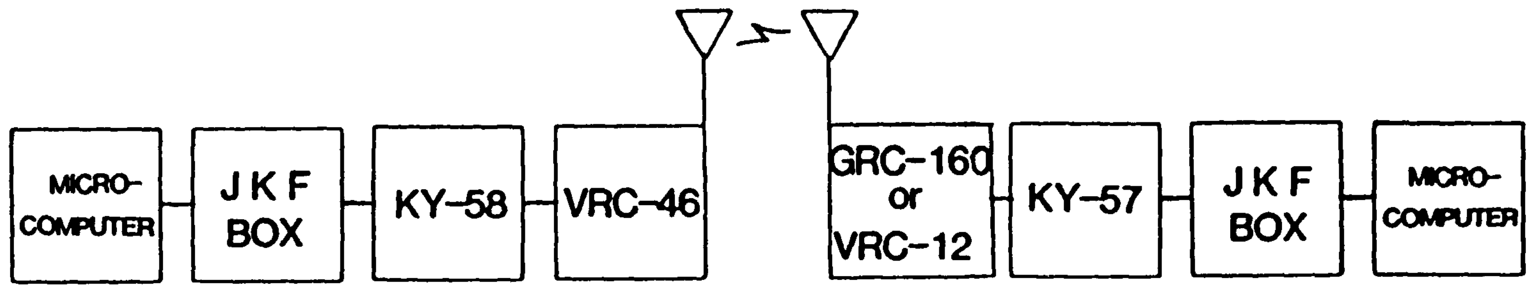

FIGURE 23. SHIP TO SHORE VHF COMMUNICATIONS SYSTEM

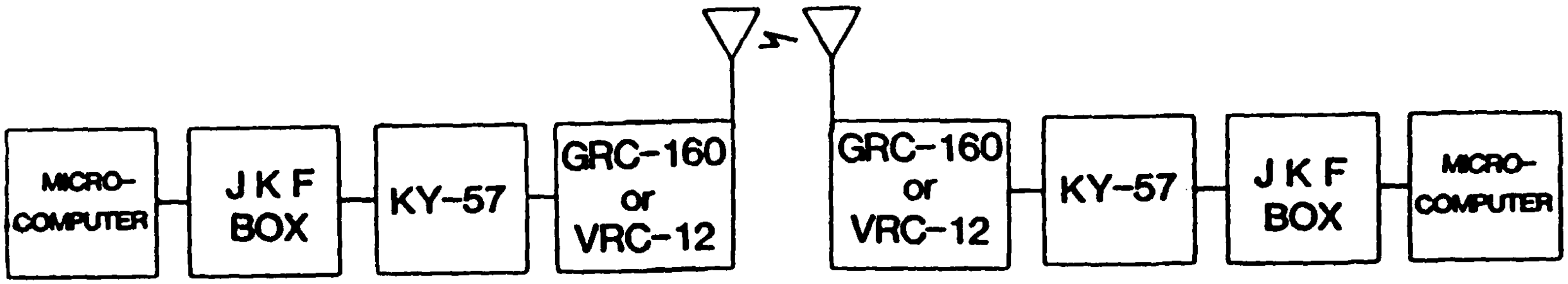

FIGURE 24. SHORE TO SHORE VHF COMMUNICATIONS SYSTEM

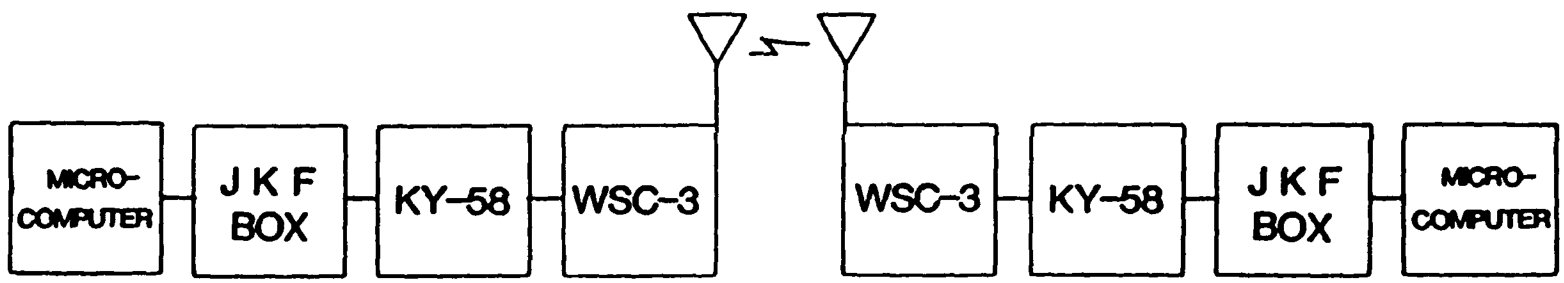

FIGURE 25. SHIP TO SHIP UHF (LOS) COMMUNICATIONS SYSTEM

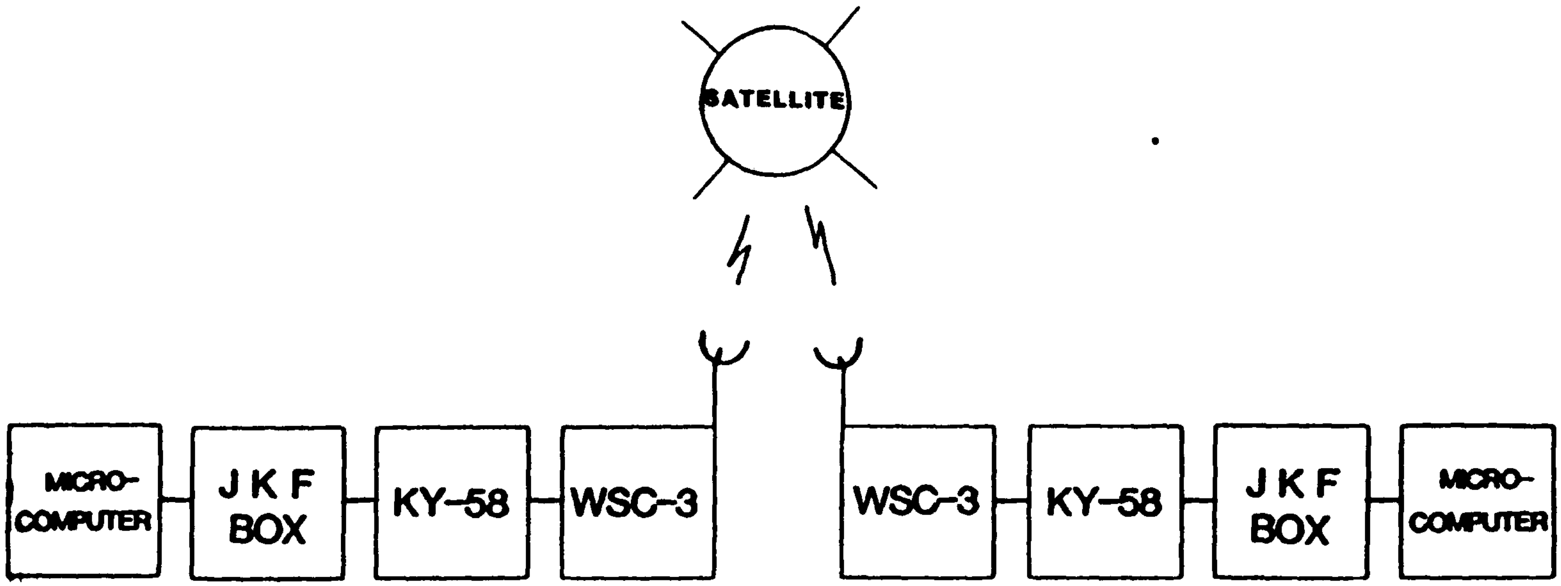

FIGURE 26. SHIP TO SHIP UHF (SATCOM) COMMUNICATIONS SYSTEM

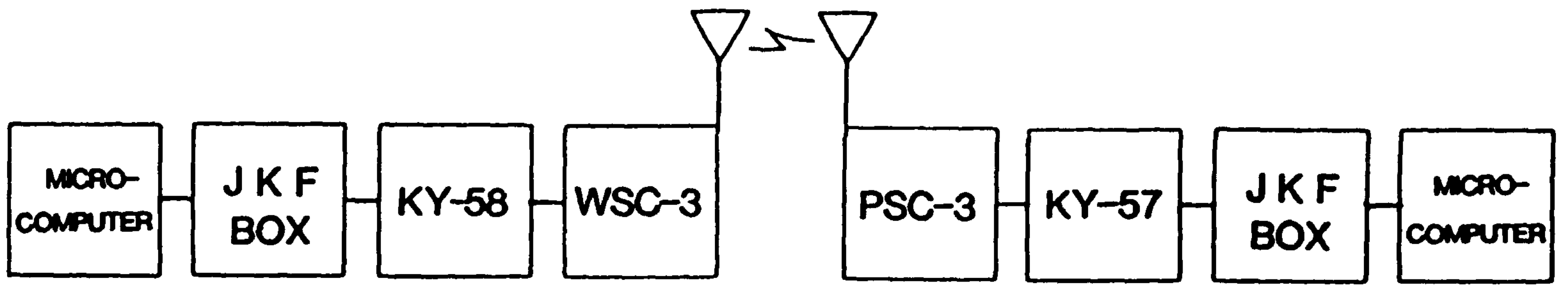

FIGURE 27. SHIP TO SHORE UHF (LOS) COMMUNICATIONS SYSTEM

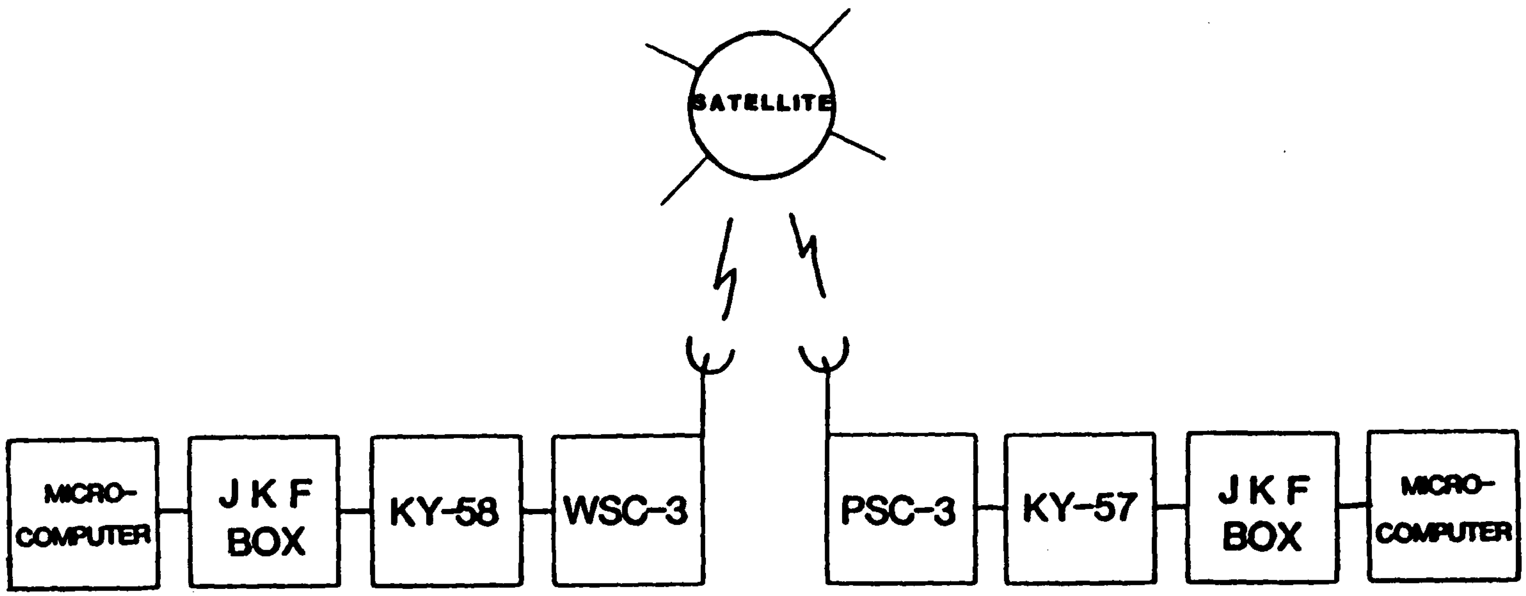

FIGURE 28. SHIP TO SHORE UHF (SATCOM) COMMUNICATIONS SYSTEM

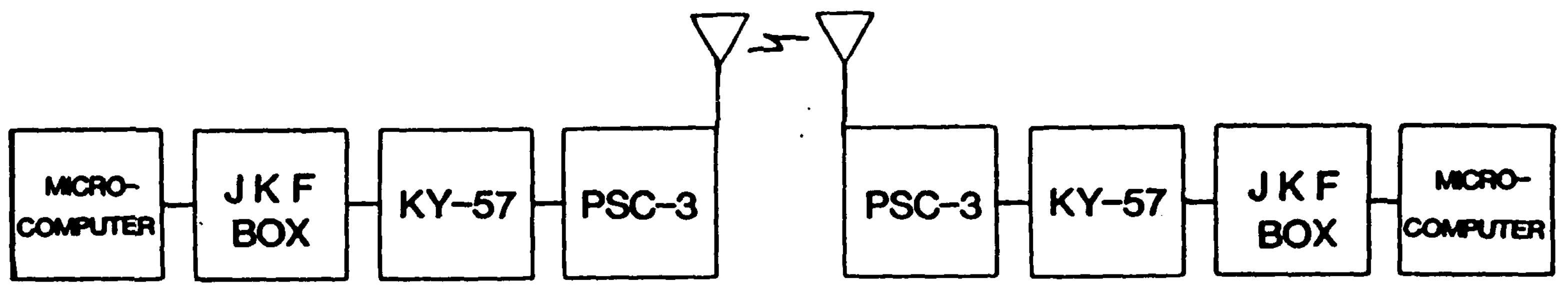

FIGURE 29. SHORE TO SHORE UHF (LOS) COMMUNICATIONS SYSTEM

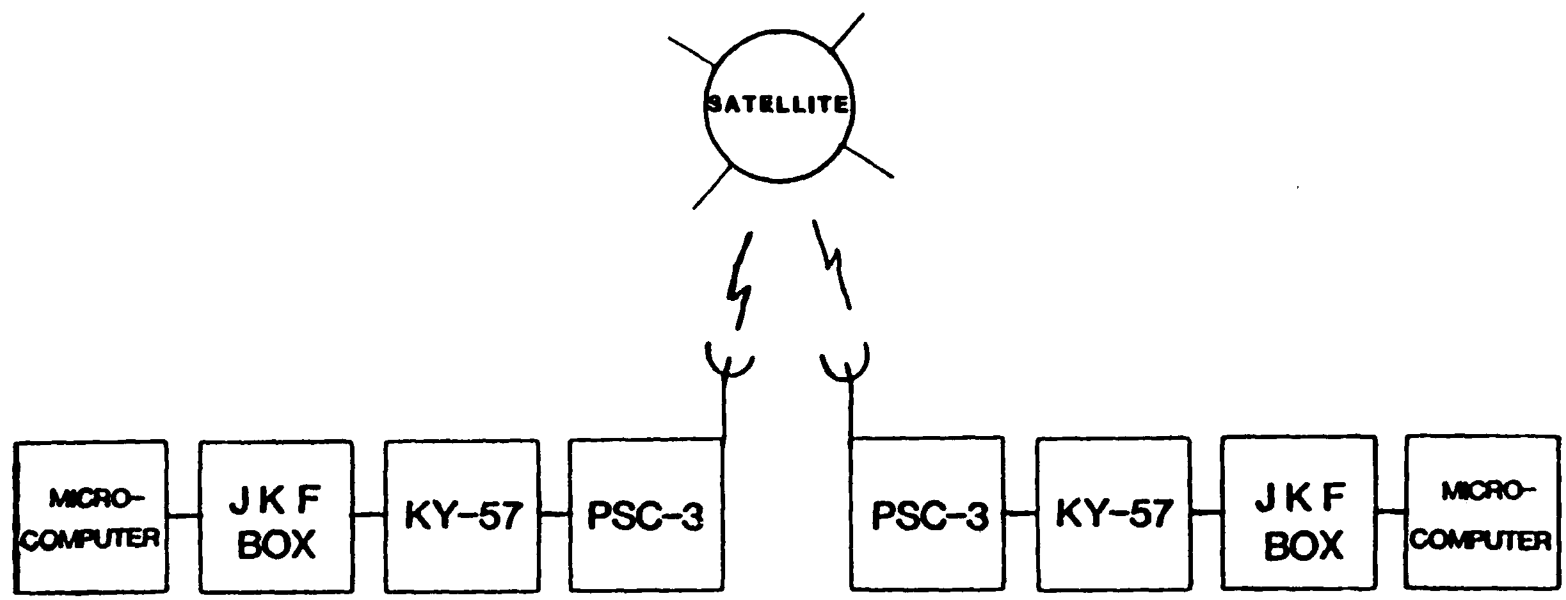

FIGURE 30. SHORE TO SHORE UHF (SATCOM) COMMUNICATIONS SYSTEM

There are three levels of communication within and among the medical treatment facilities.

One level is the cluster of computers interconnected as a local area network (LAN) or in a multidrop form at the medical treatment facilities. In the case of the medical company the number of computers presently being considered is four. They are presently to be interconnected as a LAN via coaxial cables. The present network topology for the LAN is a BUS. Alternative network topologies that could be considered are the STAR and the RING. These representative network topologies are depicted in Figure 31. Another interconnection technique being considered is the use of fiber optic cables.

A second level of communication is the use of remote terminals that are connected to the computers in the LAN. These remote terminals can be connected to the LAN via coaxial or fiber optic cables. These remote terminals could also be connected to the computers in the LAN by short range radios.

A third level of communication is between the medical treatment facilities via HF, VHF, or UHF radios. Ideally the optimum frequency, transmitter power, and data rate would be determined and used for each connectivity path.

Other Techniques. Military communications systems must be designed with the presumption that they will operate in hostile environments. Adaptive antenna systems and spread-spectrum systems are two of the most powerful methods for interference rejection.

1. Adaptive Antenna Systems. Nulls in antenna radiation patterns can often be formed in nearly arbitrary directions outside the main beam. Thus, if the arrival angles of a desired signal and interference are known and adequately separated, it is possible in principle to enhance the desired signal while nulling the interference. However, a change in the geometry due to the movement of the intended transmitter, the receiver, or the interference source may cause the interference initially in a null to leave the null. An adaptive antenna system can change the direction of a null to accommodate geometrical changes.

An adaptive antenna system automatically monitors its output and adjusts its parameters accordingly. It does so to reduce the impact of interference that enters through the sidelobes, or possibly the mainlobe, of its antenna radiation pattern, while still allowing reception of an intended

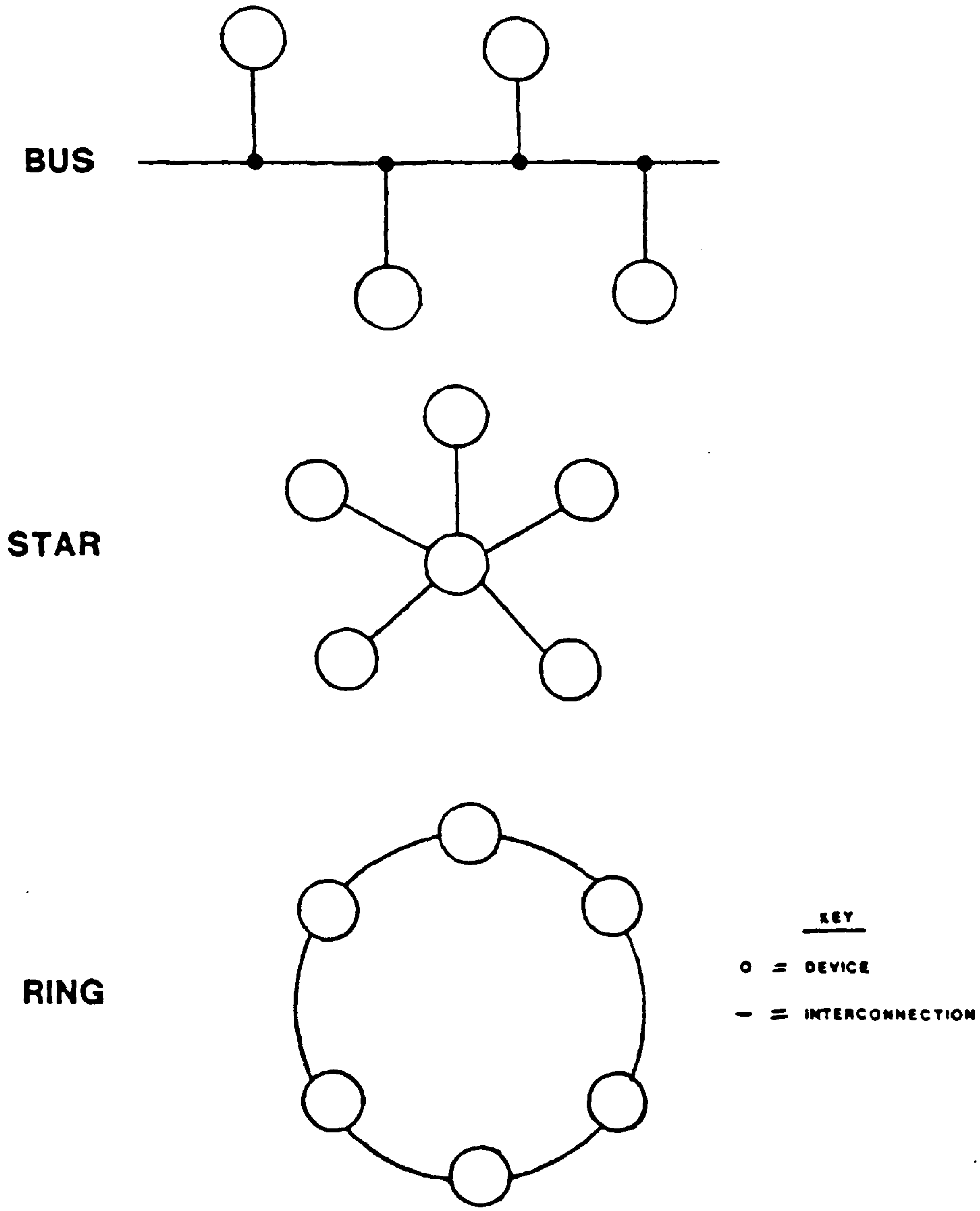

FIGURE 31. NETWORK TOPOLOGIES

transmission. The design of an adaptive antenna system requires little *a priori* knowledge of the interference characteristics.

Although any type of antenna can be used in an adaptive antenna system, phased-array antennas are the most common. A phased-array antenna consists of a number of antenna elements, the outputs of which are processed and combined to produce the desired antenna radiation pattern. In an adaptive array, usually each antenna-element output is applied to a tunable multiplier. The other input to the multiplier effectively weighs the element output. The outputs of the multipliers are summed to produce the array output.

2. Spread Spectrum Systems. A spread-spectrum system is a system that produces a signal with a bandwidth much wider than the message bandwidth. Because the spread-spectrum system distributes the transmitted energy over a wide bandwidth, the signal-to-noise ratio at the receiver input is low. Nevertheless, the receiver is capable of operating successfully because the transmitted signal has distinct characteristics relative to the noise.

The spreading waveform is controlled by a pseudonoise sequence or pseudonoise code, which is a binary sequence that is apparently random but can be reproduced deterministically by intended users. The removal of the spreading waveform from the received signal to restore the modulated message is called despreading.

Spread spectrum systems are useful for military communications because they make it difficult to detect the transmitted waveform, extract the message, or jam the intended receiver. Pseudonoise sequences give spread-spectrum systems identification and selective-calling capabilities. The most practical spread-spectrum methods known are direct-sequence modulation, frequency hopping, and hybrids of these two methods.

A direct-sequence system, which is sometimes called a pseudonoise system, spreads the transmitted spectrum by using the baseband pulses representing the pseudonoise sequence, which is produced by a pseudonoise code generator. A pulse or bit of the pseudonoise sequence is called a chip.

Frequency hopping is the periodic changing of the frequency or frequency set associated with a transmission. Successive frequency sets are determined by a pseudonoise sequence. If the data modulation is multiple frequency-shift keying, two or more frequencies are in the set that changes at

each hop. For other data modulations, a single center or carrier frequency is changed at each hop.

A frequency-hopping signal may be regarded as a sequence of modulated pulses with pseudorandom carrier frequencies. Hopping occurs over a frequency band that includes a number of frequency channels. Each channel is defined as a spectral region with a center frequency that is one of the possible carrier frequencies and a bandwidth large enough to include most of the power in a pulse with the corresponding carrier frequency. The bandwidth of a frequency channel is often called the instantaneous bandwidth.

GLOSSARY OF DEFINITIONS RELATING TO COMPUTERS AND COMMUNICATIONS

Adaptive Antenna. An adaptive antenna system automatically monitors its output and adjusts its parameters accordingly.

Assembler. A computer language useful in I/O operations.

Amplitude Modulation (AM). Modulation of the amplitude of the carrier.

Baseband. Original digital signal. Voltage level identifies information of signal--one or zero.

Bose-Chaudhuri-Hocquenghem (BCH). Error control code.

Black. The encrypted side of the communications link.

Coaxial. Refers to the coaxial cable where the signal line is in the center of the cable surrounded by a dielectric and then by the ground shield.

Common Lisp. An artificial intelligence computer language.

Conditioned Baseband. Information contained in the transitions of the wave-form with one being a change in the level at clock pulse, and zero being no change in level at clock pulse.

Conditioned Diphase. Modulation of conditioned baseband signal with a data rate squarewave.

Connectivity. The network of communication paths.

Decibel (dB). A logarithmic measure of gain or loss in terms of power or voltage.

Diphase. Modulation of baseband signal with a data rate squarewave.

Downlink. In satellite communications, the communications path from the satellite to the receiver site on the ground.

Duplex. Communication in both directions at the same time.

Expert System. An artificial intelligence system that simulates a human expert.

Expert System Shell. An artificial intelligence aid in building an expert system.

Fading. Changing of the amplitude of the signal received at the receiver.

Fiber Optics. Refers to the use of fiber optics in the implementation of communication cables.

Frequency Modulation (FM). Modulation of the frequency of the carrier.

Frequency Shift Keying (FSK). Modulation technique using discrete shifting of the frequency of the carrier.

Ground Path. The radio signal that follows the curvature of the earth.

Half-Duplex. Communications in both directions, but not simultaneously.

Hamming. An error control code.

High Frequency (HF). In the military, the frequency typically from 2 to 30 MegaHertz (MHz).

Input/Output (I/O). Refers to the communications in and out of a computer.

Ionosphere. The layers of ions at a significant distance above the earth.

KAM. Operating and maintenance instruction manuals for cryptographic equipment.

Line of Sight (LOS). Refers to the communication paths for VHF and UHF frequencies.

Local Area Network (LAN). One way of interconnecting computers.

MegaHertz (MHz). One megaHertz is one million cycles per second.

MIL STD 188. The standard military digital interface.

Modulator/Demodulator (MODEM). Device in radio that performs the functions of modulation and demodulation.

MS-DOS. A common PC disk operating system.

Packet. A subset of the data to be transmitted. It contains the address of its destination, the address of the sender and some control information. Any form of data can be placed in it, and lengthy data must be sent in multiple packets.

Phase Lock Loop (PLL). A device used to extract the clock from the carrier.

Phase Shift Keying (PSK). Modulation of the carrier using discrete phase shifts.

Protocol. A set of rules governing the exchange of data between two entities.

Red. The unencrypted side of the communications link.

Reed-Solomon. An error control code with strong error correction capability.

RS232C. The standard serial communications technique for microcomputers.

Sky Path. The communications path that the signal follows, for example, from the transmitter on the ground refracting off of the ionosphere back to the ground. There can be many refractions off of the ionosphere.

Spread Spectrum. A system that produces a signal much wider than the bandwidth. The most practical spread-spectrum methods known are direct sequence modulation, frequency hopping, and hybrids of these two methods. These systems are useful for secure communications because they make it difficult to detect the transmitted waveform, extract the message, or jam the intended receiver.

Turbo Pascal. A fast version of Pascal used on personal computers (PCs).

Uplink. In satellite communications, the communications path from the ground site to the satellite.

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Medical activities and medical communications play a vital part in support of Marine Corps amphibious operations and subsequent operations ashore. This report focuses on these medical activities and medical communications. Medical activities is the subject of the first half of this report, and medical communications is the subject of the second half of this report.

Prior to this report, a detailed and thorough research and analysis of Marine Corps operations was conducted that led to the generation of a future combat scenario and its associated conclusions. It was clear that many improvements needed to be made to ensure we survive and win any encounters with our projected opponents. These needed improvements in medical activities and medical communications come at the same time as the occurrence of advances in technology that are available to realize these needed improvements.

Now is the time to apply this new technology to help make the medical support as effective and efficient as possible from the beginning to the end of any MAGTF operations.

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